THE IRON TRADE REVIEW

VOLUME XXXII. CLEVELAND, O. MARCH 9, 1899. CHICAGO, ILL NUMBER 10

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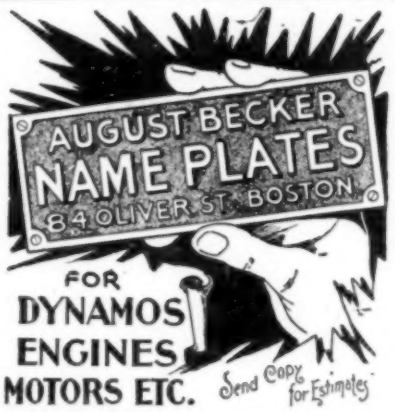

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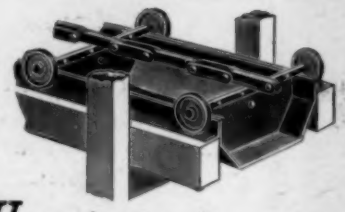

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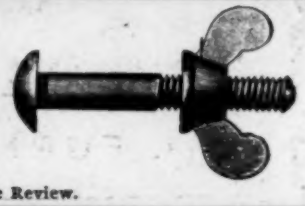

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THE IRON TRADE REVIEW

VOLUME XXXII. CLEVELAND, O. MARCH 9, 1899. CHICAGO, ILL. NUMBER 10

THE WEEK IN IRON CIRCLES.

THE MARKET AT LARGE.

The advances in iron and steel continue and $1 a ton added to the price of pig iron seems now to startle the trade less than a 25 cent advance six months ago, while $2 more on finished material is an easy possibility between any two days. Leaders in the trade still talk of the dangers of such a movement, but with legitimate demand of the proportions developed week by week, there is no longer any serious thought that it can be stopped. The ore producers of Lake Superior were moved by considerations of the highest validity—the preservation of our foreign trade and the necessity of averting any semblance of a boom—to put their prices only fractionally above last year's. Meantime the pig iron advance has been ten times that of ore, and steel billets have reached a point $10 above the price of Bessemer pig iron. And now the Central Western producers of Bessemer pig iron who are meeting at this writing to decide on what asis they will do business for the second half of the year, are hearing the suggestion that they are looked to, to save the trade from disaster. But with the ore men's experience in mind, and a full knowledge of the conditions in steel and in foundry iron, the indications are that they will not attempt the role of philanthropists. Conservative figurers predict a basis of $13.50 to $14 for round sales of Bessemer iron, third and fourth quarters; a more excitable element goes even higher. It is known, however, that large steel works will make considerable purchases of iron as soon as the price is determined. These latter concerns already know the destination of a part of their output for the second half, and the rate at which plates, sheets, tin plate, bars, structural steel and wire mill products are going into consumption, even before the open-season demand has set in, promises greater things than the present movement has yet suggested. The crops of the year will be an important element in determining the course of the market from midsummer on, but the bulk of the contracts for the second half will be made before they can become a definite factor. It is significant, as showing how deep and broad is the wave of prosperity now sweeping over the iron trade, that a large number of foundry buyers scattered over the country are seeking iron for delivery in the next two and three months, because of the unexpected output of their plants. The difficulty of taking care of such requisitions is increasing, in spite of the policy of foundry furnaces for some time back of reserving a share of their probable output for just such emergencies. Additional foundry furnace capacity will be available later, but not much before the middle of the year and then nothing large. In Virginia new ore operations must be started and in the East, New York and New Jersey will be drawn upon more than in several years. The Pittsburg market shows that all calculations as to the capacity of the steel plants to cope with the demand have gone quite astray. Producers who sold freely at the low prices, to hold the situation within bounds, find themselves now unable to take on anything more, and the result is that the condition it was attempted to avert has come with a rush. Billets are $23.50 to $24, or within $1 a ton of the highest point touched in 1895. The contract basis for the second half of the year has not yet been determined; but with Bessemer pig iron within the neighborhood of $14, valley, steel is certain to be beyond $20. A surprising development in tin plate is that while the American Tin Plate Co. has refrained from quoting, the demand for plates in second hands has carried prices 25 cents a box above the last quotation from Chicago, or to about $3.75 and $3.80 a box, an advance of $1 over the prices of last fall. Imported tin plates have advanced also in the past three months. The wire and wire nail markets continue active and mills are driven to keep up. The leading wire interest, unlike most producers, is realizing steadily on the new prices, the policy followed for some months of selling only for quick delivery saving it from being loaded up with low-priced contracts. In connection with consolidation movements, the acquisition of the Shoenberger Steel Co. by the American Steel & Wire Co. is the most improtant development. Wage advances are general, and while the body of skilled workmen in the Amalgamated Association do not get the benefit of them, the business of the next few months as higher-priced material moves out of the mills on the termination of old contracts, will establish a higher basis for next year.

PITTSBURG.

OFFICE OF *The Iron Trade Review and Industrial World.*
705 PUBLICATION BUILDING, March 8.

The market is entirely beyond control, despite the strongest influences brought to bear by the large and conservative elements in the trade. The holding down of prices which was practiced by the steel producers has really put the latter in the condition of entire inability to supply the demand, through the efforts made earlier in the present movement to take good care of the trade. There is the greatest pressure to secure raw material, and in almost every line there is difficulty and uncertain operation is the rule in many of the finishing mills. Either the demand in ultimate consuming lines is beyond anything that could reasonably have been expected, or buyers have become too excited to gauge properly the future. An evidence of the pressure in the steel market is furnished by the fact that the American Tin Plate Co. has been compelled to stop quoting on practically all inquiries while the bidding has forced the price of tin plates up fully 25 cents a box above the last regular price made by the company. This, in view of the company's position and ability to turn out material, is very significant. Prices are almost unquotable, and interest is manifested mainly in securing material on specifications. As yet no business is being done in the main lines for the third quarter, and the efforts of producers who desire to give as much stability to the market as possible will probably be turned in the direction of selling for the third quarter in a way which will help to maintain a steady level.

PIG IRON.—The last sale of Valley Bessemer iron was made at $12.50, and in the last few days no quotations have been made at all. The furnaces have but an inconsiderable quantity of iron to dispose of up to the first of July. A meeting is being held in Cleveland, at which a price for the balance of the first half will be determined upon, which is likely to be from $13 to $14, and the more important question will be taken up of selling for the third quarter. It is felt that in this way the market to an extent can be controlled. In foundry and forge irons there is very little to be had, and there is a very wide range of prices. We hear of sales of No. 2 foundry at as high a figure as $14.50, Pittsburg, while sales have also been made at $13.95 and $13.40, and perhaps in some cases lower than this. In gray forge the market is all of $12.50 in the Valley, and $13.00, Pittsburg, while a sale is reported at $13.50, Pittsburg. We quote as follows, partly nominal:

Bessemer, valley furnace	$12.50 to	13.50
Bessemer, Pittsburg	13.00 to	14.00
No. 1 Foundry	13.50 to	14.00
No. 2 Foundry	13.00 to	14.00
No. 3 Foundry	12.50 to	13.75
Gray Forge, valley furnace	12.50 to	13.00
Gray Forge, Pittsburg	13.00 to	13.50

STEEL.—The producers are practically out of the market, making only an occasional sale of a small lot to a favored customer, while the amount of steel held at second hand has been reduced to a very small volume, and the holders are loth to part with it except at the highest figure. We hear of an odd sale occasionally by a producer at $23.00, but as high as $23.50 and $24.00 has been secured, and $25.00 has been quoted in several cases. It is a frequent experience for a seller, who desires to keep out of the market, to quote a figure intended to be prohibitive, only to find it eagerly accepted. In open hearth steel almost any price can be secured, and we learn of a sale at $30, though occasionally a trifle under this has been done. In wire rods and sheet bars nothing is being done at all.

FERRO-MANGANESE.—Prices on ferro have been advanced by the leading local interest, and the market may now be called between $55 and $60 for domestic.

PIPES AND TUBES—The new list on merchant pipe is working very satisfactorily. Buyers understand that the changes in the base list were made almost entirely with a view of bringing the relative prices of different sizes to a proper level in harmony with the progress in methods of manufacture. With the old list, there was much more profit in some sizes than in others, and the specifications had much to do with the acceptability of an order, so that there was a tendency to cut the price on certain specifications, while the same price on other sizes would mean an actual loss. As it is now, there is but one discount, applying to merchant pipe, both butt and lap weld, and black and galvanized, which much simplifies things, while the profits on the different lines are on a par as near as it is possible to arrange it. This discount is 60 per cent off, with six 10's additional for less than car load lots, and an extra 5 for car load lots. Car load lots only are delivered free within the prescribed territory. A separate set of discounts applies to the new list on lap weld casing, these being 52½ and 10 for screw and socket joint casing, and 52½ on inserted joint casing, with an extra 5 per cent to dealers. Formerly the discount to dealers was nominally 2½ per cent. The new discounts on boiler tubes, adopted week before last, are, 50 per cent off for 1¼ to 1½ inch; 60 per cent off on 1¾ to 2½ inch, for iron and 65 per cent for steel; 65 per cent on 2¾ to 6-inch on iron and 67½ per cent for steel, all with an extra 5 per cent to dealers.

STRUCTURAL MATERIAL—The demand for structural material is far ahead of the season, and the advance in prices noted last week is fully sustained. Makers are being pressed by consumers who want to begin outside work in a short time. With one exception prices remain as they were at last report, universal mill plates alone having advanced. We quote: Beams and channels, 3 to 15 inches, 1.40c; 18 to 24 inches, 1.50c; tees, 1.45c; zees, 1.40c; and angles, 1.30c; universal mill plates, 1.45c to 1.50c.

RAILS AND TRACK MATERIAL.—The past week has developed no change in the rail market, the ruling figure still being $22 for standard sections. The demand for track material is increasing, with former prices held very firmly as follows: Spikes, 1.50c; track bolts, 1.65c to 1.70c; splice bars, 1.10c to 1.15c; links and pins are quoted from 1.35c to 1.40c.

PLATES.—The consumers of plates are pressing the mills worse than ever, and the demand seems to be increasing each week. Bridge building and locomotive construction cause the larger part of the present urgent call for plate material. The B. & O. will build 48 bridges during the coming season; the material, however, has been provided for. Other roads are not so fortunate, and they are now trying to cover spring wants. It is rather difficult to quote what may be considered fair market prices, as there is nothing more stable to go by than the most urgent necessities of the buyers. One sale of tank plates this week was made at 1.85c. The prices now most prevalent for June and July delivery are as follows: Tank plate, 1.75c to 1.80c; shell, 1.80c; flange, 1.85c; fire box, 2½c to 3½c.

SPELTER.—There has been a decided slump in the spelter market since our last report, as the previously high prices seem to have brought out quite a supply. Locally the figure is 6.20c; New York, 6.30c; and St. Louis, 6.10c. The zinc market also took a second drop, from which it did not rally, and high grade ore is now quoted at $40 per ton at Joplin, Mo.

IRON AND STEEL SKELP.—The pushing demand from the pipe mills is keeping skelp prices on the up grade, and higher figures are quoted this week. Among the mills there is the greatest activity and consumers are clamoring for deliveries. This week's prices are as follows: Grooved iron skelp, 1.25c to 1.32½c; sheared iron skelp, 1.45c to 1.50c, grooved steel, 1.20c to 1.25c; sheared steel skelp, 1.30c to 1.35c.

OLD MATERIAL.—There is a large demand for scrap material, but comparatively little is moving, as holders are waiting for higher figures. There is not a great deal of material in the yards, and dealers are showing no great eagerness to push sales. Prices in all grades are advancing, and this week we quote: Melting stock, $12.25 to $12.50; old steel rails, long lengths, $11.25 to $11.50; cut, $11.75 to $12; old iron rails, $17; wrought iron scrap, $13 to $13.50 valley; cast borings, $7 net, valley; busheling scrap, $9.50 to $10, net; car wheels, $12 to $12.50 gross; cast scrap, $10 gross; charcoal scrap, $11 gross; wrought turnings, $7 to $7.50 net valley. A large local interest has made a deal with a mill east of Pittsburg by which the former trades pig iron for scrap. The transaction involves quite a large tonnage.

CHICAGO.

OFFICE OF *The Iron Trade Review and Industrial World.*
1522 MONADNOCK BLOCK, March 8.

The market continues to gain in strength, and advances were made last week on several grades of iron and steel. The tonnage of business, outside of pig iron, was not large, as mills cannot take care of anything like all the orders offered. Buyers are anxious to make purchases, but in many lines find it difficult to get mills to accept orders for anything like nearby deliveries. Sales of pig iron last week were larger than for several weeks previous, with prices considerably higher. Orders for about 4,000 cars are being figured on by the car works and these will be placed soon.

PIG IRON.—Considerable business was done last week, the total sales of both Northern and Southern iron approximating 35,000 tons. The largest order closed was for 15,000 tons of Northern iron; other orders were for 6,000, 3,000 and 2,000 tons, with a number of smaller lots. Advances have been made in all grades of pig iron in the week, and while the larger part of last week's business was done at the old prices, considerable sales have been made since the advances went into effect. Most of the large buyers appear to have satisfied their immediate wants, but the prediction is made that before the end of the year they will find additional purchases are needed to meet their growing requirements. Some of the smaller foundries are still in the market, and these will make a considerable aggregate of buying in the immediate future. Furnaces are exceedingly firm in their views, and in no case has any inducement been offered to secure business. On the contrary, orders have been reduced in size in several instances, because the furnaces were not willing to take the full tonnage asked for by the buyers. Quotations are revised as follows:

Lake Sup. Charcoal	$14 50 @ $15 00	Southern Coke No. 3	$13 75 @ 14 25
Local Coke Fdy. No. 1	14 50 @ 15 00	Southern No. 1 Soft	14 50 @ 15 00
Local Coke Fdy. No. 2	14 00 @ 14 50	Southern No. 2 Soft	14 25 @ 14 50
Local Coke Fdy. No. 3	13 50 @ 14 00	Southern Silveries	14 50 @ 15 00
Local Scotch Fdy. No. 1	14 50 @ 15 00	Jackson Co. Silveries	14 50 @ 15 00
Local Scotch Fdy. No. 2	14 00 @ 14 50	Ohio Strong Softeners	14 00 @ 14 50
Local Scotch Fdy. No. 3	13 00 @ 14 00	Alabama Car Wheel	17 50 @ 18 00
Southern Coke No. 1	14 50 @ 15 00	Malleable Bessemer	14 50 @ 15 00
Southern Coke No. 2	14 25 @ 14 50	Coke Bessemer	14 50 @ 15 00

BARS.—Orders were hardly as large last week as in the week before, but were of considerable size, and included several large contracts. Buyers were of all classes, including car works, agricultural implement manufacturers and wagon builders. A number of large inquiries are in the market and will be closed soon. Prices are still on the upgrade, and all low priced iron seems to have disappeared from the market. Common iron is quoted at 1.30c to 1.40c, with a few sales taken last week at a little under the minimum figure. Steel bars are firm at 1.40c to 1.45c. Guaranteed iron is quoted at 1.40c to 1.45c. Nothing further has been heard regarding the proposed combine of bar makers.

RAILS AND TRACK SUPPLIES.—The local mills closed orders of about 6,000 tons of all kinds of rails last week. The de-

mand for light rails is good, and several quite large inquiries are in the market. Quotations are as follows: Standard section rails, $23 to $24; light rails, $21 and upwards; steel splice bars, 1.15c to 1.25c; track bolts with square nuts, 1.80c to 1.90c; hexagon nuts, 1.90c to 2c; spikes, 1.55c to 1.60c.

CAR ORDERS.—An orders for 500 car was placed with one of the western car works last week. The Pennsylvania and Lake Shore roads are figuring on purchasing about 2,000 cars each, and will place the orders soon. The demand for car material of all kinds is large and good sales were made last week.

BILLETS AND RODS.—No business of any size was done in this market last week. The local mills took no orders of either billets or rods. Open-hearth billets are quoted nominally at $25; Bessemer billets, $24; rods, $29.

STRUCTURAL MATERIAL.—Last week was quiet, with no large orders placed and no new business coming up. General business was excellent, and included several good sized contracts. The market is very firm, and plates are higher. Quotations are as follows: Beams, 15 inch and under, 1.55c to 1.60c; 18 inch and over, 1.65c to 1.70c; angles, 1.45c to 1 50c; sheared plates, 1.80c to 1.90c; universal plates, 2c to 2.10c; tees, 1.55c to 1.60c; zees, 1.55c to 1.60c. Small lots from stock are quoted at ¼c to ½c higher.

PLATES.—The demand continues large, but mills are able to take very little new business, and this limits sales. Orders from store are large and buyers appear perfectly willing to pay asked prices to secure the material. Quotations are again higher, as follows: Tank plates, 1.80c to 1.95c; flange steel, 1.90c to 1.95c; marine, 2.05c to 2 10c; fire box steel, 2.25c to 4c.

SHEETS.—The demand continues large, and sales last week were of good size. The market is very strong and prices have advanced. No. 27 black sheets are quoted at 2.35c to 2 45c, and galvanized at 75 to 75 and 5 per cent off, with freight allowance.

MERCHANT STEEL.—Sales last week were of good volume, and included two or three quite large contracts. The demand is still large. Quotations follow: Open-hearth spring, tire and machinery steel, 1.75c to 1.80c; smooth finished machinery steel, 1.60c to 1.70c; smooth finished tire, 1.50c to 1.60c; tool steel, 5.50c to 7c; specials, 10c and upwards.

WIRE AND WIRE NAILS.—The situation is unchanged. There is a demand for all kinds of wire and nails, and sales last week were excellent. Prices are unchanged as follows: Wire nails, $2; painted barb wire, $2.10; galvanized barb wire, $2.50; plain, $1.85; all at Joliet, in car lots; less than car lots are quoted 10 cents higher.

SCRAP.—The demand for most varieties of scrap is large, and sales last week showed an increase over those of the week previous. No very large sales of any grade of scrap were made in the week. The market is firm, and prices are growing stronger. Dealers' selling prices are as follows:

Old iron rails, gross,	$14 50@$15 00	Axles, net	$16 00@$16 25
Old steel rails, long, gr.	10 75@ 11 00	Cast borings, net	4 75@ 5 00
Old steel rails, short	8 75@ 9 00	Wrought turnings, net	7 00@ 7 50
Old wheels, gross	14 00@ 14 50	Axle turnings, net	7 50@ 8 00
Railroad forge, net	14 00@ 14 25	Mixed steel, gross	7 00@ 7 50
Dealer's forge, net	11 50@ 12 00	Stove plates, net	6 25@ 6 50
No. 1 mill, net	8 50@ 9 00	Heavy melting steel, gr.	8 50@ 9 00
Heavy cast, net	10 00@ 10 25	Old iron splice b., net.	14 25@14 75
Malleable cast, net	8 00@ 9 00		

CLEVELAND.

OFFICE OF *The Iron Trade Review and Industrial World.*
27 VINCENT ST., March 8.

Inquirers for ores are still being heard from, but not all are getting what they go after. On such lots as have been disposed of recently an advance of 35 to 40 cents above opening prices is secured, and this is about the advance dock stocks have brought, over the 1899 basis. Some undesirable Bessemer ores are unsold on the docks, but no non-Bessemers; and while from 1¾ to 2 million tons may be on the docks May 1 it will be furnacemen's ore, with insignificant exceptions. The prediction that old range material sold for 1899 delivery will not all come down is made by high authority in the trade. Whether this will develop an actual shortage or only compel changes in mixtures later in the year, it presents possibilities furnacemen will not want to encounter. Some recent ore transactions were made possibly by the resale from a furnace firm's hands of a round lot of Mesabi ore. From the new range sales are much larger than last year's. Eastern furnaces have not come up to their purchases of 1898 thus far. Perhaps 700,000 tons have been sold to this trade. Cuban ores will come in, of course, in larger quantities than in 1898, but these ores are all sold up to the amount that can be shipped. Local ores may help out, and it is known that New York ores have been sent into Pennsylvania in larger quantities than usual. Deals in Lake Superior mining property, and rumors of deals, are still plentiful. The Lake Superior Iron Co.'s would-be-buyer is still in the back-ground. The Carnegie Steel Co., Federal Steel Co. and National Steel Co. are about equally named in this connection. On the Mesabi range the acquisition of the Clark & Sauntry property in the Virginia district by the American Steel & Wire Co. is reported.

PIG IRON.—A meeting of the Bessemer association is in session in Cleveland at this writing and the outcome will be the determination of the price of Bessemer iron for the third quarter of the year. Steel works are ready to buy and the naming of a price is expected to be followed by considerable transactions. Indications point to a price not lower than $13 50 and not higher than $14, valley furnace. Some small lots have been sold the past week at $12.75 and $13, but none to steel works. The extraordinary spread between Bessemer iron and billets—about $10, as represented by recent sales—has advanced the ideas of furnacemen, even those among them who have been exerting themselves to prevent a boom. Foundry iron, too, is something of a criterion. It is expected that two furnaces of one producer in the Pittsburg district and one of another will be out of blast for a part of the second quarter, and most of the steel works of the Central West will be buyers within the next few weeks. Foundry iron has advanced from 50 to 75 cents in the week. Sales of No. 2 foundry are reported at $12.50 and $12.75 in the valley, and $13 has been paid in some cases. The furnaces have so little iron for delivery before July that they are taking business from regular customers only, and not much from them. Lake Superior charcoal has been sought by buyers who for some time have taken coke iron instead. All the charcoal furnaces are sold ahead for months, and are now quoting $14.50 Lake Erie dock. Gray forge is not to be had in the valleys for early delivery, but the last sale of Southern was at $12.85 delivered, yet Southern quotations to-day are 25 to 50 cents higher than this. Last sales of valley gray forge were at $12.50, furnace, but more would be paid to-day to get the iron. We quote as follows:

Bessemer	$13 65	Valley Scotch No. 1	$14 15
No. 1 Strong Foundry	13 75@14 25	Valley Scotch No. 2	13 65
No. 2 Strong Foundry	13 25@13 75	Gray Forge, valley	12 50
No. 3 Foundry	13 00@13 25	Lake Superior Charcoal	14 50@15 00

FINISHED MATERIAL.—Advances are regular and expected features and on the small amounts of material they can get for delivery in the next 60 days buyers are paying them without a murmur. The plate market is scarcely quotable. Small orders are being squeezed in now and then, when mills with low-priced contracts choose to give themselves a taste of business with good profits. We quote tank steel at 1.95c to 2c. Sheets have been advancing at the rate of $2 to $3 a week. Mills keep sales within about a 60-day limit, as sheet bar supply and price are uncertain elements. Sales have been made at 2 50c, Pittsburg mill for No. 27, and local jobbing prices are 2.60c to 2.70c. Bars have advanced to 1.25c and 1.30c at valley mill for iron, with half extras, and Cleveland sales are at 1.45c, out of stock. Steel bars are firm at 1.35c, Pittsburg, and some sellers quote 1 40c. There is a steady demand and the mills are well booked to the middle of the year. Sales of pipe are made at the advanced prices from stocks in second hands, this being a much surer source of supply than the mills. On boiler tubes recent quotations figure about one-sixth above previous prices, both on iron and steel. There are good prospects in structural lines from bridge and architectural work, but present business is largely in specifications on contracts. Local wire and nail mills are crowded with orders, both export and domestic business being of large proportions. We continue the quotations of last week: To large buyers these are $1.85 for wire nails in car load lots; smooth wire, $1.70 base; painted, $2.10; barb wire, $1.95 for painted and $2.35 for galvanized.

OLD MATERIAL.—Sellers are advancing prices and there is a comparatively active market. Some quotations are higher than those we give: Old iron rails are $16 to $16.50; old steel rails, $1 to $11.50; old car wheels, $13 to $14—all gross tons. We quote No. 1 railroad wrought scrap, $14 to $14.50; No. 1 machinery scrap, $9.50 to $9.75; iron axles, $16; wrought turnings, $8 to $8.50; cast borings, $6.75 to $7 25; grate bars, $7—net tons.

THE IRON TRADE REVIEW
AND
INDUSTRIAL WORLD.

DEVOTED TO MACHINERY, METAL-WORKING AND FOUNDRY TRADES AND IRON AND STEEL MANUFACTURE.

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NEW CAPITAL WILL NOT LIGHTLY ENTER.

Referring recently to one effect of the present consolidation craze, with its attractive and quick profits to the promotors and original holders, we said that the unwillingness of capital to consider ordinary industrial investments was holding back projects that could not offer the advantages of complete control in a given line. The bearing of this condition upon the course of the iron market in the next year or two is vastly important. We are accustomed to say that advancing prices in any line, caused by steadily increasing demand which demonstrates at length the inadequacy of producing capacity, will be checked in time by the inflow of capital into new plant. Attractive profits have always stimulated investments. Applying the rule to the present situation in the iron trade, the conclusion might be drawn, that the period of remunerative prices on which iron manufacturers have recently entered would be attended with the erection of many new plants; and that the ensuing period of slackened demand, whenever it comes, would find an overdone industry, with resulting demoralization. The transition from feast to famine can be made so quickly in the iron trade of the United States that the shadow of the one seems not far from the presence of the other. But it is evident that the reaction from the boom that is now under full headway will not be due to the building of new plant. Reserve capacity that is neither modern in equipment nor in output, may come into line, here and there. Pennsylvania and Virginia will make the principal contributions, so far as blast furnaces go. As long as prices hold at to-day's level such plants, where they can get an ore supply, can give back to their owners in a short time all that it will cost to refurbish them, and even in a brief campaign earn a fair profit. When the succeeding decline reaches a point at which retirement again becomes necessary, they can resume their places in the idle column, and leave the battle to the strong.

There is a great difference between the aftermath of such an expansive movement and that of a period of prosperity that gives stimulus to the erection of new plant of modern type. The present concentration of iron and steel interests seems to guarantee that the next additions will be in the shape of extensions by the strong companies themselves. At the rate the world's wants in iron have grown in the past three years the period of overproduction that has covered most of the present decade may be followed by a considerable period in which highly effective plants will be operated to their fullest extent, at good profits; while the size of the investment required and the upheavals to which the industry is subject latterly, will make it more than ever an industry which new capital will not readily enter.

Personal.

M. M. Garland, formerly president of the Amalgamated Association, is in Washington this week testifying before the Industrial Commission created some time ago by the Phillips bill. It is made up of five senators, five congressmen and three representatives each from the manufacturers, labor organizations and agricultural interests.

Andrew Carnegie is expected to return to Skibo Castle, Scotland, in May. A recent statement concerning Mr. Carnegie's gifts shows that he has given $6,174,500 for the establishment of 24 free libraries or institutes in this country and Scotland, and his conditional offers now outstanding, all of which will be accepted, will take $2,000 000 more. The list of gifts shows that $5,100,000 was expended in founding the institutes and libraries at Pittsburg, Allegheny, Braddock, Homestead, Duquesne and Johnstown.

Thomas Hobart died at East Orange, N. J., March 4, aged 80 years. From 1852 to 1872 Mr. Hobart was associated with Edward Lewis in the management of the Lake Erie Iron Works, of Cleveland, O.

J. R. George, chief engineer of the Joliet Works of Illinois Steel Co., has resigned his position to become a member of the engineering force of Morgan Construction Co., Worcester, Mass.

S. T. Wellman, of the Wellman-Seaver Engineering Co., Cleveland, starts in a few days on a trip to Europe.

W. P. Snyder, the well known iron and steel dealer, of Pittsburg, after an illness of several weeks, returned to his office 10 days ago, but since that time has become critically ill.

L. E. Cochran, president of Andrews Bros. Co., Youngstown, O., is reported very seriously ill.

President A. J. Moxham, of the Lorain Steel Co., Daniel Coolidge, vice-president, P. M. Boyd, treasurer, and Max M. Suppes, general manager, are named as incorporators of a new bank at Lorain, O.

THE Page Woven Wire Fence Co has commenced the erection of its plant at Monessen, Pa.

JOHN JONES, general manager of the Michigan Iron & Steel Co., Muskegon, Mich., recently re-organized, has been in Pittsburg ordering new machinery for an addition to the plant. It is stated that about $200,000 is to be expended in improvements.

THERE has been considerable difficulty at the Allegheny works of the Pressed Steel Car Co., starting from a demand of the company that the riveters double the amount of work done per day, and a number of small strikes have occurred. The company has just announced an increase in wages for all the workmen, averaging something over 5 per cent, and it is probable that this will lead to a settlement of the difficulty, the day's work for the riveters being considerably reduced from the company's first demand.

THE latest Pittsburg venture in labor journalism is the *Labor World*, which recently sent out its first number. The paper shows brains and vigor, and is managed by a board consisting of the heads of iron and steel labor organizations.

THE CONSOLIDATIONS.

The National Steel Co.'s offices were established the past week in the Marquttee Bldg., Chicago. Some detail connected with the transfer of plants required attention first The transfer of the Buhl Steel Co. has now been concluded. The two furnaces of the Sharon Iron Co. at Sharon, Pa., which have furnished basic iron for the Buhl open-hearth plant are under contract to go under the control of the National Steel Co. The same is true of the Semet-Solvay by-product coke plant of the Sharon Iron Co., Ltd. But neither matter has been closed up. In order to supply its puddle mills with iron, the Sharon Iron Co. has purchased the Sharon Furnace at Sharon, and will have it in operation in April. The Union Iron & Steel Co., Youngstown, is now known as the Union department of the National Steel Co., with W. E. Taylor as manager. The sending of large amounts of money to Youngstown as the result of the National Steel transfers (It is understood that two-thirds was taken in cash, this being stipulated by the promoters), has started some discussion of a new steel works project for Youngstown; but there is no definite move in that direction. The managerial talent of the Ohio Steel Co. is well committed to the consolidated company.

The effort to bring 35 rolling mills west of Pittsburg under the control of a single big corporation is making headway slowly. Appraisals have been made and a considerable number of options have been taken, but up to date less than half the plants are under option. The task is a herculean one; and the time it will take, and the changes in the opinion of moneyed men respecting iron industrials that may take place before it is concluded, are distinct handicaps.

The bridge consolidation scheme, promoted by J. Gifford Ladd, with its $50,000,000 proposed capitalization is now an assured success; and again, according to report, is doomed to failure. Some of the insiders are very sanguine of the outcome The head of a large Eastern structural and construction company is named for president of the consolidation. One of its features is the control of the output of structural mills, and it is here that difficulty is being encountered.

The capitalization of the tube works consolidation is put at $60,000,000, half 7 per cent cumulative preferred stock. The National Tube Co. will be the corporate name, being almost the same as that of the National Tube Works Co., which will represent a large part of the stock of the new company, while its president, E. C. Converse, will be president of the National Tube Co. J. Pierpont Morgan & Co. have financiered the consolidation, which is to take in the well known wrought pipe and tube companies of Ohio, Pennsylvania and New York and one in Delaware. Of the total annual tonnage, about 1,195,000 tons, it is expected that the combination will control 1,131,000 tons.

The United States Cast Iron Pipe & Foundry Co. has been incorporated under New Jersey laws the past week, with a capital of $15,000,000 preferred and $15,000,000 common stock. In addition to the plants already secured, it is understood that negotiations are under way for the foundry of J. B. Clow & Sons, at Newcomerstown, O. The dividend on the $12,000,000 preferred stock of the company will be $840,000 a year, which means about $2.50 a ton against the possible product of the plants included. This would seem to be leeway sufficient to tempt capital into a thoroughly modern and well located competitive plant.

There remains to be mentioned the consolidation of the ship building companies around the great lakes. The plants that are known to be in the deal are the Globe Iron Works Co. and the Cleveland Ship Building Co. of Cleveland; American Steel Barge Co., of West Superior; Chicago Ship Building Co., of South Chicago, Milwaukee Dry Dock Co , of Milwaukee, and the Detroit Dry Dock Co., of Detroit. The property of all the firms was appraised by experts several weeks ago and all that matter is in the hands of the committee having charge of the consolidation. The capital stock of the company has not been definitely decided upon, but it will not be far from $15,000,000. The appraisals and the capitalization have been made on a particularly conservative basis, and practically all the stock will be taken up by the stockholders of the constituent companies. Unlike most of the consolidation deals, this is initiated and handled by owners and not by outside promoters. Underwriters will be a superfluity. A meeting held in Cleveland the past week brought plans well along and their consummation is expected soon.

STRIKE NOTICE ON MARQUETTE RANGE.

The mine workers' union at Ishpeming, Mich., which has had a precarious existence since the strike of 1895, on the Marquette range, that ended so disastrously for the miners has reappeared as a disturbing element. Its secretary, Matt Wasley, who has had a salary from such of the miners in that district as were willing to follow his lead, sent the following notice to the Cleveland-Cliffs, Lake Angeline and Lake Superior companies, of Ishpeming, within the past few days:

On the 6th day of February, 1899, a request was sent you to the effect that a 15 per cent advance was not only desirable but expected. As yet no answer has been received, but a disgraceful subterfuge has been offered. At a meeting of the mine workers held on the 4th inst., it was carried unanimously that unless an answer affirming the 15 per cent raise from the old schedule be given out officially by you before the 9th inst., we cease to labor until such request is granted.

As we have noted already, an advance of 10 cents a day—and in the case of common laborers 15 cents—was granted surface men and other company account workmen in the Ishpeming district, this going into effect March 1. Surface laborers who received $1.35 a day in December, are now paid $1.50. Engine house men who received $1.80 and $1.85, now receive $1.90 and $1.95. Underground company men also received the 10 cents a day advance. The wages of contract miners, which were already higher in the Ishpeming district than on other ranges, as ascertained by a careful collection of wage statistics, were regarded to be quite as high as the situation warrants. The December pay rolls of Ishpeming mines show that contract miners received an average of $2.08 a day. At a representative property on the Menominee range this average was found to be $1.95; at an important group of mines on the Gogebic range, $2, and on the Vermilion range, $1.88. The mining companies on the Marquette range have felt, in view of the small advance made in the price of ore this year, and the high rate of wages now ruling, the advances of March 1 fully measured up to what the conditions warrant The ore prices of 1899 are a matter of record, and ore buyers have found out, if the leaders of the Ishpeming union do not know, that the entire product for 1899, with insignificant exceptions, was sold at the low opening prices; so that the ore producers have not participated at all in the benefits of the advance which has kept the iron trade on the qui vive in the past few months. The tone of the demand just submitted at Ishpeming is not that of the representative intelligent labor for which this district is noted. As in 1895 the men have evidently been led away by irresponsible agitators, who have jumped at the conclusion, just as they did in 1895, that because pig iron and steel and finished material, are advancing, the iron ore industry is reaping corresponding profits. As has been said repeatedly in these columns in the past few weeks the iron ore men are alone in failing to participate in the splendid prosperity now coming to the iron trade. It was a mistake, easily seen to-day, but not foreseen by the wisest heads in the trade; but it is done and cannot be undone. Distinct advances have been made in Lake Superior mining labor since last year, but the mining companies cannot share with labor that which they do not get. It would be a pity if the disastrous struggle of 1895 were repeated for the sake of finding out what the men have every facility for finding out in advance, if they will but investigate.

The annual dinner of the Cleveland Chemical Society was held at the Hollenden Hotel, Monday evening, March 6. S. T. Wellman made the address of the evening on "Thirty Years' Progress in Steel Making."

The Cary group of iron mines of the Gogebic range, operated under lease by the Odanah Iron Co , are about to be started up again. Pumping and bailing are under way and it is expected that mining will be resumed some time in April. The property was closed down in May, 1897, and since that time the ore sold has come from the Lake Erie docks and from stock piles at the mines. S. S. Curry is president of the Odanah Iron Co. and H. S. Haselton, secretary. The selling agents are Pickands, Mather & Co., of Cleveland.

The next meeting of the Western Foundrymen's Association will be held at the Great Northern Hotel, Chicago, Wednesday, March 15, at 7:30 p. m.

TESTING MACHINES.*

BY F. A. RIEHLE.

It is a strange coincidence that our first paper upon the subject of "Testing Machines" should be read before the Foundrymen's Association of Philadelphia, and that the first testing machine our firm was called upon to design and construct was for a Philadelphia iron foundry. The party referred to was at that time one of the most prominent in this locality, and the member of the firm who called to consult about it and finally ordered the first tester is still living. I mention this fact because most of the firms with which we had dealings, nearly 33 years ago, have passed away — that is to say, the partners of the firms, and especially the senior members. The name of the gentleman above mentioned is Mr. Samuel Fulton, of the firm of S. Fulton & Co., who had an extensive pipe works at Conshohocken, near Philadelphia.

The necessity for a machine was urgent, and it was of the greatest importance that we should have it constructed as rapidly as possible in order to make an immediate investigation as to the strength of the iron used in the pipe they had constructed for a contract. We never learned as to the quality of the iron tested but understood that it was satisfactorily demonstrated that the quality of the iron was up to the specifications, and are under the impression that the information thus gained settled a pending lawsuit and that it was in favor of our Conshohocken friends.

The matter of physical testing of materials, while it may be considered a hackneyed subject to many, is, we believe, just in its infancy, and we are convinced that the time will come, and in fact is near at hand, when every up-to-date manufacturing plant will be considered to be ill-equipped without a testing department. In fact, some parties have stated that they consider their testing machine the most important tool in their works and, to quote from their letters, they say: "We could not run our establishment without it." While very important results are being obtained by the testing of materials in the form of test specimens, the most valuable and far-reaching results will be obtained by testing all forms of machinery, or sections of machinery, and structural forms in their full, usable size, as far as it is possible. and by an occasional test of such forms to destruction. The desire for a test of this nature is manifested when a test is made of a bridge after it is placed in position, by loading it with a very, very great weight. This has been, and can be, done by placing upon it as many of the heaviest type locomotives as it will hold; this test goes to check up or prove the result obtained by theory and by testing the component parts of the bridge upon a testing machine. Frequently parties prove the strength of a small structural member by piling railroad iron or pig iron upon it up to the full strain to which it will ever be subjected in actual practice. This is a very satisfactory and correct way of testing, and in the absence of a large enough testing machine to take in these small structures (we of course do not refer to a large bridge) is the only proper test that can be obtained.

At the present time chain manufacturers are required to make tests of the chain after it is finished and ready for use, and one section of chain in every certain number (say every 10 or 20 sections) is broken. Spring makers also test their springs under the same conditions as they are used in actual practice. Building material, small structural pieces such as brake beams, car bolsters, etc., can be tested with beneficial results in the sizes used; also timber and similar material. The benefit of testing materials to destruction and in full sizes is being more appreciated daily, and the most important results have been attained, and especially in regard to tests of timber. As far as we know, the testing of timbers has been more exhausted than that of any other substance. The United States Government has accorded a great deal of attention to this matter, and furnished extensive and elaborate reports based upon the results of these experiments. Extensive and valuable researches have been made by the United States Government of iron, steel, and alloys at the Watertown Arsenal by carefully prepared test specimens; but these tests are not as important to iron and steel manufacturers and users as if the material was tested in full sizes. It is an important fact, and should not be overlooked, that tensile tests of small specimens run up higher than tensile tests of the same material in larger sections.

Some time ago a very large contract was made for furnishing steel bridge members in large diameter—we think in five inches diameter, perhaps more The contract was based upon the result of experiments and tests made on the same quality of material in the form of test specimens one inch or one-half inch area. The result was that the strength of the large members did not come up to the specifications and the material was rejected, and the consequence was it ruined the company. Any one can constitute himself a testing machine by breaking a piece of thread or cord, thereby making a tensile test; or, he can break or bend a piece of wood or thin piece of steel upon his knee, making a transverse test. A person makes a compression test when he steps upon a floor or frail piece of mechanism. The comparative strength of two, three or more specimens can be very readily perceived, but the test is limited to the strength or weight of the individual. This method of testing, or some crude device, will answer for some people, and has served for everybody—before the introduction of testing machines. Every one wants to procure the strongest material obtainable, provided the price and other requisites, such as appearance, bulk, etc., are suitable. Then arises the question, not as to whether one specimen is stronger than another, but precisely how much stronger. Frequently parties have found upon investigation that they are using too much material for their purposes or necessities; then comes the matter of economizing or reducing the size or quantity of the article sufficiently to meet their ends.

The pipe manufacturers were among the first people to purchase and use testing machines. Four or five firms procured them in quick succession; among others, R. D. Wood & Co. for their Florence Works, Warren Foundry, and several others. Soon after a law was passed in Congress that all iron and steel used in the construction of boilers for the United States Government should be tested for tensile strength. It required that coupons should be cut from boiler plate and each coupon tested for its tensile strength. The United States was then divided into ten districts. It may have been divided into more; but an order was given for 10 testing machines for 10 districts; probably the other districts were not important enough to require a testing machine for this purpose. At the present time we think there are 14 or 15 districts in the United States, and are under the impression that each district has a testing machine for this special purpose. At this time (we refer to the time when the Government supplied itself with the first testing machines), the testing of iron, metals and alloys received greater attention, and the action of the United States Government led to the use and purchase of testing machines by all the prominent boiler plate makers, and subsequently by rolling mills, steel and iron works. Shortly after this period testing machines were introduced into colleges and universities in the departments of mechanical engineering. Simultaneously with this wider use of machines, railroad companies took up the matter of physical testing of materials, and physical testing laboratories on varying scales were established by the leading railroad companies throughout the United States. The Pennsylvania Railroad was among the first to avail itself of the advantages of this new device and procured a couple of Riehle testing machines over 20 years ago. We believe they are in active use at the present time, and have been continuously since the time of their installment.

To trace the use of machines still further, we might add that the pig iron manufacturers began to appreciate the value of testing their iron before placing it in the hands of the public, and they too invested in testing machines. The manufacturers of charcoal iron invested first, and subsequently the manufacturers of anthracite iron. Since this time the large machine shops and progressive manufacturers of every kind of material have been making physical tests of the articles entering into the production of their finished goods. And then more recently still, all manufacturers who can possibly arrange it are testing the actual finished product in the full size and form in which it is used in practice.

It is impossible to give you an adequate idea either of the variety of testing or a list of the various articles to which tests are, and can be, applied. As to the articles, the prin-

* Read before the Foundrymen's Association, Philadelphia, March 1, 1899.

cipal tests are of iron, steel and alloys; then building material, such as wood, bricks, stone, asphalts, cement, etc.; then wire, chain, wire and hemp rope, cloth, canvas, leather and canvas belting, leather, oils (for their lubricating qualities), hose (for its resistance to bursting), brake beams, car bolsters, car springs, parts of bicycles, wheels, etc.

Some of the tests on these articles are by tension, transverse and compression strains; torsion or twisting strains; abrasion, indenting, shearing, bursting; and we might include a drop test of brittle substances, such as crockery ware, glassware, etc., which test is introduced by the United States Government in its Quartermaster's Department.

The extensive use of wire for telegraphs, telephones, musical instruments, etc., has led to the construction of testing machines built especially for testing this substance. Wires are made of alloys (many of them), and manufacturers desire to test the quality of different mixtures and temper of the wires by pulling, bending, twisting and breaking; also breaking by the greatest number of bendings, just as one would break off a small piece of wire with the fingers, and they come with all their various and difficult problems to the testing machine manufacturer to devise some special appliance to satisfy their every want. One piano maker wished to procure a wire of a certain mixture, size and temper, such that a given strain applied to it would produce a certain tone, say key of A or B, and so on. This required fine calculations and great skill on the part of the manufacturer and finisher of the steel. We merely mention this incident to show how testing and results go hand in hand.

The first machine constructed at our works was a very crude affair compared with the style of testing machines made since. It consisted of a compound parallel crane beam suspended in a wooden frame about eight feet high, and from a stirrup connected with an old-fashioned Shaw & Justice hydraulic jack. Below the crane beam were suspended tools for gripping the end of the tensile test specimen. Secured to the lower part of the frame were the tools for gripping the other end of the tensile test specimen. On a wooden projection rested a hand power hydraulic pump. From this pump was adjusted a tube carrying the fluid from the pump below to the cylinder of the jack. As the pump was operated the plunger of the jack, the stirrup and the crane beam were raised, and the test specimen being secured in the grip holders was strained and the strain weighed by weights placed on a bale or weight-dish suspended from the end of the crane beam. While plain and true, it was still an accurate and reliable testing machine, but exceedingly awkward.

The next style of testing machine was one of 150,000 lbs. This machine was as crude as the one just described. The crane beam, plunger, jack, and hand pump were the same as used in the first machine; but instead of the test specimen being pulled direct away from the crane beam, the latter was connected with the lever which increased the capacity of the crane beam five times. From this increasing lever the tensile tools were suspended and the specimen secured thereto. Both these machines, or machines precisely similar, and made by us, have been in constant use ever since they were made. We made several of each form. One of the first boiler plate makers to buy one of these large machines was Messrs. Gaylord & Co., Portsmouth, O. Since these first crude machines were constructed many improvements have been made in every direction. The first machines, as you were informed, were made with wooden frames. They were afterwards made with iron frames. The first call for iron frame machines was from the Government, which ordered 10 iron frame machines for the Department of Supervising Inspectors of Steam Vessels. Then, as the requirements of the public demanded, machines were made in larger capacity and for a greater range of usefulness. Afterwards, parties required that machines should be arranged to work automatically; that is to say, as the strain increased, by means of the straining mechanism, the poise on the beam, instead of being moved by the hand, was advanced by an automatic appliance. The poise moved out until the weight on the beam exceeded the strain on the test specimen, when the beam dropped and the motion of the poise ceased until the strain again increased. By an adjustment, the poise can be made to move quicker or slower, so the beam will act more in harmony with the quality and nature of the test specimen. If the test specimen is brittle, the poise must advance quickly, or else the specimen will break before the poise reaches the breaking strain on the beam. On the other hand, if the test specimen is tough or ductile, the beam must advance much slower than the straining mechanism. The skill and experience of the operator will soon determine the proper speed of the automatic adjustment.

You might be interested in some incidents that occur in connection with a testing laboratory. The experience is certainly a varied one, and you would be surprised to hear a list of the articles and materials that come to hand for testing. It would be impossible to give you a list, but we might mention some. Some one brings a small article, so small that it is impossible to hold it in the grips; others, too large pieces, that it would be impossible to test as they desire. We have made tests of cold pressed bolts, and hot pressed bolts, for their shearing qualities. One party brings an ordinary nail and a patented nail, and wants to prove, by way of experiment, for a patentee or publication, which nail requires the most pressure to make it pass into a piece of wood, and wants another test to see which style of nail takes the strongest hold on the wood, and then to compare the appearance of the fibres of the wood which the nails have displaced. People bring a piece of pig iron for tensile test—even a brick for tensile test. These we inform them have to be properly shaped to make a suitable test. Another party wants to learn the strain, by pressing, that the hub of a wheel will stand, by the pressure of a spoke into the hub; namely, an ordinary hub as compared with a patented hub and spoke. The first bicycle wheel, now in common use, was tested at our laboratory, and the results surprised both the maker and the patentee. Frequently very suspicious pieces of metal come to us to be tested and the parties require that an affidavit of the test be made by the engineer. This savors of the unpleasant suspicion that we may be called upon to give some testimony in a court. We even had a piece of rope sent us to be tested, and while the matter was never plainly mentioned, from what we gathered it gave color to the impression that it was tested for the purpose of seeing if it was strong enough to hang a man, with success—not to the man, but to the municipal authorities.

Some time ago, one of the senior partners of an iron concern still in existence came to see us and, evidently in a disturbed state of mind, inquired whether we kept a record of the tests we made from time to time. The reply being in the affirmative, he requested a duplicate report of a test made on a certain date be given him, as he had lost the original. During the time the search was being made for the report asked for, it was very evident that this same gentleman was intensely exercised in his mind. In a short time he was informed that the report of the test was found and he was handed a duplicate copy. Upon receiving the copy he said: "This report is worth $6,000 to me, as it settles a dispute in our favor in which the matter of the strength of the material tested was brought up, and I see that the report is as I recollected and informed the other parties, but nothingcould be done or settled until this report was reproduced."

One of the smallest machines we ever made was on an order of a gentleman who came to see us, who asked for a tensile testing machine so small that it would break specimens of iron or steel about the size of the lead in an ordinary wooden lead pencil. This gentleman was Dr. P. H. Dudley. As you no doubt all know, this gentleman is a railroad company's doctor, and is called upon to solve every mechanical problem that can be conceived of arising in the operating of a railroad company outside of the bookkeeping and accounting departments. You have all heard of his car in which he and his wife lived and made their permanent home, if a home that is never permanent can be so called. Dr. Dudley was taking cores out of the web and flange of steel and iron rails and testing these diminutive specimens for their tensile strength; making comparative tests and drawing his inferences and results therefrom, and reporting to his clients the results. We carried this diminutive testing machine under our arm down to Washington st. wharf to the home-car, and as far as we know it is in active use up to the present time.

At a meeting of the Western Soil Pipe Association, held at Milwaukee, March 3, it was resolved to advance the price of iron pipe 5 per cent.

A SURPRISING CONDITION IN TIN PLATE.

A wholly unexpected state of affairs has developed within the past few days in the tin plate market, the fact being that the bidding of consumers has run the price of tin plate fully 25 cents a box above the latest regular quotation made by the American Tin Plate Co. Until about a week ago, when all regular quotations were stopped, the company's price has been $3.50 for 100-lb. cokes at mill, but owing to the rush of orders and the difficulty of taking care of the business accumulated in view of the scarcity and high price of raw materials, the company quit quoting for a period. A small quantity of tin plate was available in second hands, and the demand has forced the price up notch by notch until the market may fairly be called $3.75. There have been transactions of small volume, and in cases where offers have been made to the tin plate company for special lots which were in stock or which could be readily produced, they were accepted, but the company is practically bare of stocks of all sorts at all of the mills. It was at first felt in some quarters that there was cause for complaint at the advances made since the first of the year by the new company, but the present state of affairs, with what may be called an open market, is a proof that the demand for tin plate is in line with the rush to secure material, at any price, in other iron and steel lines. An interesting feature of the situation is the fact that the foreign market has also been advancing, and it is not now possible to import coke plates within 50 to 75 cents of the price prevalent three months ago—a very unusual rise in a market which has for some time past been very steady, with fluctuations which were frequent, but of small scope.

The Cincinnati Iron Market.

March 7.

The past week has been another one of great activity in the market as far as Southern iron is concerned. Sales of No. 2 foundry have been made at $10.85 and of No. 1 soft at $11, while it is currently reported that $12 is being asked by one company for No. 2 foundry. Very large sales have been made for delivery during the last six months of the year. There is a steady demand for quotations for this extended shipment. Of course it is out of the question to sell iron for prompt delivery, for all the iron that the furnaces can make for the next six months has already been sold. Buyer and seller apparently are all at sea. Evidently neither has yet lost confidence in the situation, for the buyers are taking iron as fast as the sellers offer it. The pace the market is going, is so fast that it would seem there must be a stop soon, although there is no sign of cessation at the present writing. The Southern furnaces are exceedingly careful about making any prices on any grade, being so heavily over-sold, and are continuing a very conservative policy as to prices. Northern irons have been taken up to such an extent that many of the furnaces are unwilling to accept any more orders for any grades. We quote for cash f. o. b. Cincinnati: Southern coke, No. 1 foundry, $13.50 to $13.75; No. 2, $13.25 to $13.50; No. 3, $12.50 to $12.75; No. 4 and gray forge, $12 00 to $12 25; mottled, $12.00 to $12.25; No. 1, soft, $13.50 to $13.75; No. 2, soft, $13 25 to $13.50; Lake Superior coke, No. 1, $13.00 to $13.25; Lake Superior coke, No. 2, $12.75 to $13; Hanging Rock charcoal, No. 1, $16 to $17; Jackson Co. silvery, No. 1, $13 85 to $14.00; Standard Georgia car wheel, $15.25 to $15.75; Hinkle Lake Superior charcoal, $15.00 to $15.50.

No Increase in Tin Plate Tonnage Wages.

It has been decided for the present that under the sliding scale in force there can be no increase in the tonnage wages paid by the American Tin Plate Co. The wages are based on the relative price of tin plate and steel billets, and it was expected that the advances in tin plate would bring an advance to the workers under this arrangement, but an investigation has shown that the price of billets has advanced very much, thus preventing an advance in wages, although it is true that a considerable part of the advance in tin plate has been due also to the heavy advances in pig tin, of which the scale does not take any account. The company has, however, made a voluntary advance to all workmen not governed by the scale, including day labor and all, the advances ranging from 5 to 10 per cent. This affects the plants of the company all over the country.

SALE OF SHOENBERGER STEEL CO.

It has already been noted in these columns that negotiations were being conducted by the American Steel & Wire Co. looking toward the acquisition of at least the rod mill of the Shoenberger Steel Co., now being built. It can be stated on the best authority that this week negotiations have been concluded, with the exception of one or two minor details, about which there is no question, by which the American Steel & Wire Co. will acquire by purchase the entire property of the Shoenberger Steel Co., including the ore and coke interests, blast furnaces, open-hearth and Bessemer steel mills, and the finishing mills, including the rod mill under construction. The price paid cannot be learned, but in view of the intrinsic value of the property, and its desirability to the purchaser, it may be concluded that a very good price is being paid.

The Shoenberger concern is one of the oldest of the iron and steel firms in the Pittsburg district, the first blast furnaces having been erected in 1865. For some time a large part of its product was cut nails and horse shoes, made from puddled iron; but of late additions have been constantly made and the product much diversified. The company has coke works in the Connellsville region, and for a time had an interest in the Sellers Ore Co., owning a mine on the Mesabi range, but this was sold last year. There are two blast furnaces, producing gray forge, Bessemer, and basic pig iron, for the company's own consumption. Their capacity is about 150,000 tons a year. The steel making capacity consists of two 6-ton Bessemer converters, a 12-ton acid open-hearth steel furnace, and two 35-ton basic open-hearth steel furnaces. The finishing mills include a large plate mill, 34x127 inches, trains for rolling bar steel, skelp steel, etc., and a rod mill now being built, the foundations for which are about completed. The annual capacity is rated at 100,000 tons of open-hearth steel ingots, 175,000 tons of Bessemer steel ingots, and 00,000 tonsof rolled products.

British Iron and Steel Prices.

In view of the rapid advances in all iron and steel prices in the past few weeks and the contraction of the export trade likely to result, prices of material on the other side are of more than ordinary interest. From English exchanges we take the following quotations of Feb. 23, with corresponding prices in the preceding week and the preceding year:

	Feb. 23, 1899.	Feb 16, 1899.	Feb 24, 1898.
PIG-IRON—	s. d.	s. d.	s. d.
No. 3 foundry, Middlesbrough	48 0	48 3	40 9
Warrants, "	47 10	47 11	40 7
Scotch warrants, Glasgow	54 8½	54 6	45 8½
Hematite warrants, West Coast	59 6	60 1	49 2
Cold blast (foundry), South Staffs	100 0	100 0	97 6
Welsh hematite, Cardiff	61 0	62 0	51 0
MANUFACTURED IRON & STEEL—	£ s. d.	£ s. d.	£ s. d.
Marked bars, South Staffordshire	8 0 0	8 0 0	7 10 0
Common bars "	6 15 0	6 15 0	6 0 0
Steel rails, Middlesbrough	4 15 0	4 15 0	4 10 0
" West Coast	4 12 6	4 12 6	4 0 0
" Cardiff	4 15 0	4 15 0	4 10 0
Steel angles (eng.), Middlesbrough	6 17 6	6 17 6	5 10 0
" " Glasgow	7 0 0	7 0 0	5 10 0
Steel plates (ship), Middlesbrough	7 2 6	7 2 6	5 10 0
" " Glasgow	7 2 6	7 2 6	5 10 0
	s. d.	s. d.	s. d.
Tinplates, Bessemer I. C. cokes, South Wales	11 6	11 3	9 9

It is rumored about Pittsburg that the leading interest is in the market for a lot of 80,000 tons of pig iron. As this interest recently made an important trade with a steel mill, east of Pittsburg, whereby it gave pig iron in exchange for melting scrap for the open-hearth department, the report is discredited, at least as to the large tonnage of pig iron reported to be desired.

An arrangement has been made by the American Tin Plate Co. whereby it secures the right to use the apparatus for charging annealing furnaces designed and patented by F. I. Freeman, of the Totten & Hogg Iron & Steel Foundry Co., Pittsburg. The use of the apparatus for annealing, in sheet mills and in outside tin plate mills now erected, is not affected by the contract which has been made. The device is already in operation in several of the mills of the American Tin Plate Co.

WAGE ADVANCES IN THE IRON TRADE.

Moorhead Bros. & Co., of Pittsburg, announced an advance of 5 per cent in wages at the Sharpsburg plant. The puddling rate is thus brought to $4.20.

The Schoen plant of the Pressed Steel Car Co. has announced advances in wages ranging from 5 to 10 per cent.

At Birmingham, Ala., the Sloss Iron & Steel Co. and the Tennessee Coal, Iron & Railroad Co. have advanced the wages of their coal miners 2½ cents per ton, or from 40 to 42½ cents.

Vice-president Warner Arms, of the American Tin Plate Co., has sent out from Chicago a notice of an increase of 5 to 10 per cent in the wages of all workmen in the company's plants whose wages are not fixed by the Amalgamated Association scale. All labor receiving less than $1.50 a day will be advanced 10 per cent.

Pennsylvania Bolt & Nut Works, Lebanon, Pa., announce a 10 per cent increase in puddling and rolling departments, effective April 1.

Employes of Swede Furnaces, Swedeland, Montgomery county, Pa., have received an advance of 10 cents a day.

The Federal Steel Co. sent out notices last week of an advance in wages at the Illinois and Wisconsin plants of 8 per cent, to take effect March 1. The advance effects about 15,000 workmen and makes a difference in the pay rolls of about $250,000. President Buffington, of the Illinois Steel Co., said the advance was warranted by the general prosperity in the iron trade.

The Bethlehem Iron Co., Bethlehem, Pa., has announced an increase in wages of 10 per cent, affecting common laborers.

The Ohio Iron Co., Zanesville, O., has made an increase of 10 per cent in wages, taking effect April 1. It applies to about 200 men.

The Aschman Steel Casting Co., Sharon, Pa., has advanced the wages of employes earning from $1.25 to $2.00 a day 10 per cent.

At Milwaukee the employes of the Rundle-Spence Mfg. Co., manufacturers of soil pipe, have been given an advance of 5 per cent.

At Wheeling, W. Va., a conference of the employes and management of the Riverside Iron Works considered the request of the employes for an increase of 10 per cent in wages and it was granted. The new scale, which will go into effect on March 12, affects only the steel workers. The question of an increase for pipe mill workers is pending.

Notices have been posted at the Kimberly mill at Greenville, Pa., of an advance of 10 per cent in the wages of all employes not under the Amalgamated scale. Twenty puddling furnaces are in operation.

The Baker Chain & Wagon Manufacturing Co., of Allegheny, has made a voluntary advance of wages in all departments. The men receiving $2 25 per day and less have been advanced 10 per cent, and those receiving $2 50 and over 5 per cent. It benefits 300 men.

The Maryland Steel Co., of Sparrows Point, Md., has announced a 10 per cent increase in the wages of all employes.

THE partnership formed March 1, 1894, for the term of five years, between Edgar T. Ward, George Nash, and John Ward, trading as Ward & Nash, has been dissolved. On Jan. 17, 1899, Edgar T. Ward and John Ward sold to George Nash all their interest in the store stock, and business carried on by Ward & Nash at 35-37 South Canal St., Chicago, Ill., and have purchased all George Nash's interest in the store, stock and business, carried on at 23-25 Purchase St., Boston. A new firm has been formed, consisting of Edgar T. Ward, and his sons John Ward and Edgar Ward, who will continue the business in Boston under the style of Edgar T. Ward & Sons. In addition to the Dannemora tool and self-hardening steel, special spring wire, springs and polished shafting, the firm makes a specialty of sand blast machinery, controlling the sale of the Tilghman apparatus covered by the Tilghman and Mathewson patents.

THE Magnetite Foundry Co., St. Louis, Mo., has contracted for a foundry 80 x 200 feet, to be built on modern lines. The building will be of brick, and the Pittsburg Bridge Co. has the contract for 80-foot span iron Fink trusses. Pneumatic hoists will be a feature of the shop equipment.

A Modern Sheet Bar Mill.

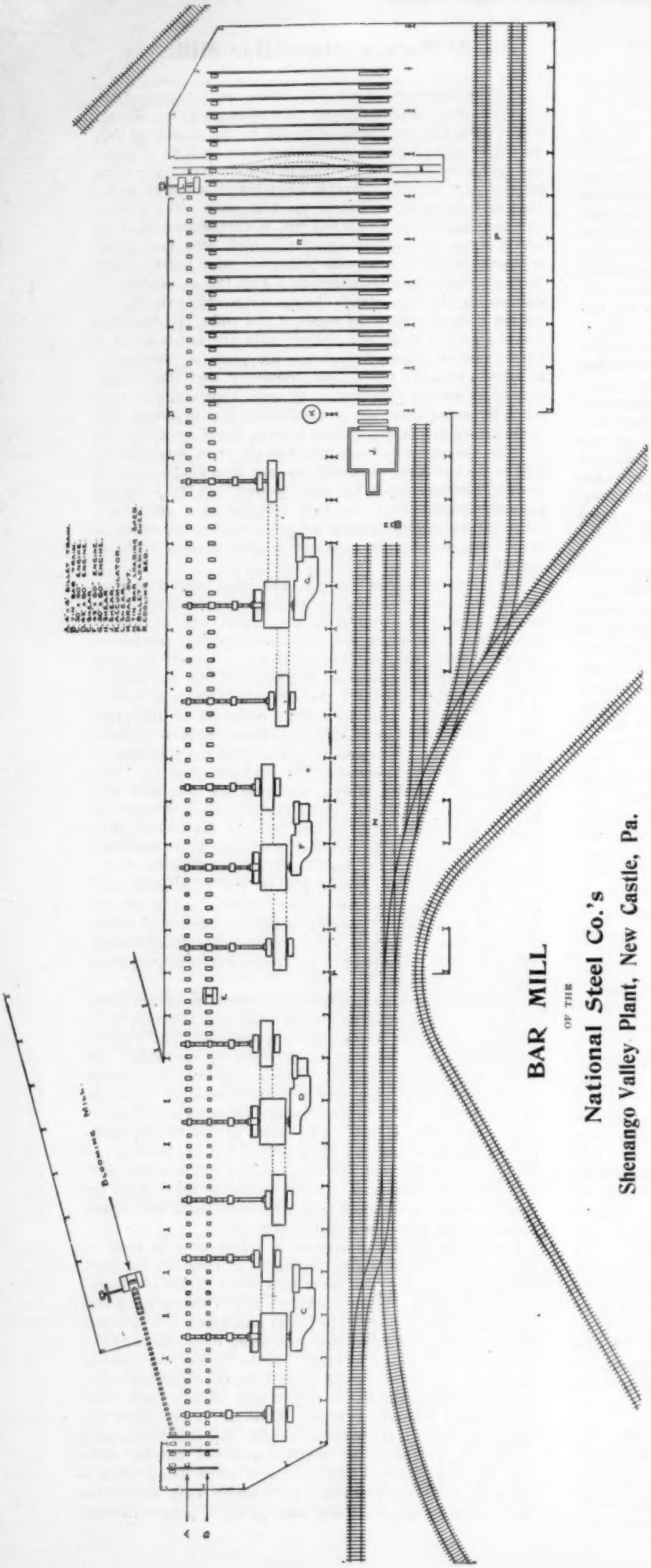
The continuous mill for rolling billets and sheet and tin plate bars at the National Steel Co.'s Shenago Valley Works, New Castle, Pa., until recently owned by the Shenango Valley Steel Co., is the most recently built of this class of mills, and is of a design entirely unique in this country. The more usual type of bar mill embodies a number of stands of three-high rolls, or with additional two-high mills. The nearest approach to the New Castle bar mill is a continuous sheet bar mill in which there are groups of two high rolls, each group containing three pairs of rolls, which are close together, and through which the piece passes as a unit, the successive reductions in the three stands being necessarily carefully arranged with relation to the speed of the rolls. In the New Castle plant the stands of two-high rolls are arranged at a considerable distance apart, so that the piece is customarily in but one pass at a time. The simplicity and trustworthiness of such an arrangement is at once apparent, and even when the experiment was untried, the only objection that could be urged to it was that on account of the length of the mill and the amount of time involved, the piece might be too cold at the last pass. The mill has now been in operation for several months, and it has been proved that this objection was wholly unfounded, the bars finishing at a good heat, although at several points a good volume of water is forced against the bar in transit in order to rid it wholly of scale.

The Shenango Valley Steel Co. built its original steel plant in 1892, there being two 8-gross ton Bessemer converters. The annual capacity is rated at 400,000 gross tons of ingots. Soon after construction was begun on the new continuous billet and sheet bar mill, the erection of a 30-mill tin plate plant was started, to consume a portion of the bar output. When just about completed, the tin plate plant was sold to the American Tin Plate Co. and the remainder of the property, including the steel making department, the 36-inch blooming mill, and the continuous billet and sheet bar mill, passed, on Feb. 25, into the control of the National Steel Co. The New Castle Wire Nail Works, including rod mill, wire mill and wire nail works, were under the ownership of the Shenango Valley Steel Co. for a time, through the consolidation with the company of the New Castle Wire Nail Co.; but these were sold recently to the American Steel and Wire Co.

The accompanying ground plan of the continuous mill shows the general arrangement very clearly, and it will be noted at once that the amount of ground covered is something unusual. It may be stated further that if any change were desirable, it would be in the direction of occupying more space rather than less.

The ingots are cast 17x19 inches, and about 72 inches long. They are bloomed down on a 36-inch two-high blooming mill, driven by a pair of 42x60 reversing engines. The blooms weigh a trifle over two tons, being about 33 feet long, and 4x11½ inches in cross section. This size permits the section which is to become a 4x4 billet to be rolled on edge, while the sections which are to become 12-inch sheet bars are rolled flat, being spread ½-inch. This width of bar is very satisfactory for sheet and tin plate rolling, but the tendency is toward even wider bars, and the Shenango mill is so arranged that much wider bars can be rolled whenever the demand for them develops, and a width as great as 20 inches is not unlikely to be reached, when the conditions call for it.

The continuous mill consists of 12 trains of rolls, each of the first 11 trains containing two stands of rolls, the last train being a bull head for the sheet bars only. There are, therefore, 11 stands of rolls for the billets, and 11 stands and a bull head for the sheet bars. The bloom is sheared into a number of pieces, the number and size being determined by the weight of sheet bar in the order. In the case of the heavier bars, each section is to make a single bar 90 or 120 feet long, and the length of the slab is determined on this basis, what is left being run into a billet. A rather heavy sheet bar would require that the bloom be sheared into four pieces, each of the first three being the weight of a 90-foot finished sheet bar, allowing for waste, and the fourth piece being what is left over, and being probably a trifle longer than any of the other three. Each of the first three pieces is passed through



BAR MILL
OF THE
National Steel Co.'s
Shenango Valley Plant, New Castle, Pa.

the first series of rolls, making a 90-foot sheet bar, while the fourth piece passes through the billet rolls, making a 4x4 billet. The three sheet bar sections would follow each other in close succession. For the lighter weights of sheet bars, instead of shearing the bloom into rather short sections, the length is made double what it otherwise would be, and after passage through the first six passes, the bar is cut in half at shear E, the two pieces then passing side by side, one somewhat in advance of the other, through the remaining six stands of rolls, each of which has a double pass. This method of working is necessary only on the lightest weights of bars. An important feature of this peculiar type of mill is the fact that, on account of the practical independence of each stand of rolls from all the others, very heavy drafts are possible, so that the work of reduction is accomplished with an unusually small number of passes. With the heavier sections of bars, in fact, the whole 11 stands of reducing rolls are not used, one, two, three or four being spread so that no reduction is made by them.

On the billet side there are 11 stands of rolls. Each stand is turned with three grooves. One line of grooves is used until it is worn out, then the next line, and then the third, so that turning is required only at rare intervals. Between the fifth and sixth stands of rolls the billets are turned and given a flat pass in the sixth stand, after which they are turned and rolled on edge as before. The billets as they emerge from the last pass continue their motion in a straight line to the billet shear L, where they are sheared.

At intervals on the sheet bar side are arrangements for spraying water on the bar during its passage. The number of these arrangements in action is determined by the weight of the bar, and whatever scale there may be on the bar is wholly removed. The bars emerging from the bull head pass to the cooling bed R and are gradually transferred to the opposite side, where an accumulation of 12 bars are sheared at a time to the desired length, ready for rolling into sheets or tin plate. The distances between the successive stands of rolls are as follows:

From first to second,	34 feet.
From second to third,	34 feet.
From third to fourth,	25 feet 4 inches.
From fourth to fifth,	34 feet.
From fifth to sixth,	34 feet.
From sixth to seventh,	42 feet.
From seventh to eighth,	35 feet.
From eighth to ninth,	35 feet.
From ninth to 10th,	37 feet 4 inches.
From 10th to 11th,	41 feet 8 inches.
From 11th to 12th,	54 feet.
Total	406 feet 4 inches.

This gives a total length from the first stand to the last of 406 feet 4 inches. The 12 trains of rolls are arranged in four groups for driving purposes, each group of three trains being driven by a separate engine. Each engine is coupled direct to the middle train of the group, and drives by a rope drive, forward and backward, to the other two trains. The first group is driven by a 50x60 automatic engine, the shaft of which carries two 20-foot rope sheaves, one driving a 24-foot sheave on the first train and the other a 20-foot sheave on the third train. This engine is usually run at about 40 revolutions, giving speeds of 33⅓, 40 and 40, for the first three trains respectively. Their pitch diameters are 24-inch, 26-inch and 28-inch respectively. The second group, comprising the fourth, fifth and sixth trains, are driven by a 42x60 automatic engine, usually run at about 50 revolutions. It carries two 20-foot sheaves, driving to a sheave 21 feet 8 inches in diameter on

the fourth train, and one 20 inch in diameter on the sixth train, giving to the fourth, fifth and sixth trains speeds of 46, 50 and 50 respectively. The third group, comprising the seventh, eighth and ninth trains, is driven by a 42x60 automatic engine, usually run at about 65 revolutions, and driving the three trains at the same speed with 20-foot sheaves. The fourth and last group, comprising the 10th, 11th and 12th trains, is driven by a 50x60 automatic engine, usually run at about 75 revolutions, and carrying two 20-foot sheaves, driving to a sheave 21 feet 8 inches diameter on the 10th train, and one 18 feet in diameter on the 12th train, giving the 10th, 11th and 12th trains speeds respectively of approximately 69, 75 and 83.

The tables between the rolls are all electrically driven, with a separate motor for each table, the power being communicated by single rope drives from one roll to the next.

In a mill of this type, success depends very largely upon the design and construction of the various transfer mechanisms and the shears. The smallest error would cause a disproportionate amount of trouble. To John Stevenson, Jr., superintendent of the Shenango Valley Steel Co.'s whole plant, is due most of the credit for the design, construction and operation of the mill, while credit is due also to William Lewis, his assistant, who has had more immediate charge of the plant, especially since the accident to Mr. Stevenson, which has confined him to his home for some time.

The mill proper was built by the Robinson-Rea Manufacturing Co., Pittsburg, recently consolidated with the Leechburg Foundry & Machine Co. to form the Mesta Machine Co.; the mill engines (as well as the pair of engines driving the blooming mill) by Mackintosh, Hemphill & Co., Pittsburg, and the bar shear by Henry Aiken, Pittsburg. Gram Curtis, chief draftsman of the Shenango Valley Steel Co., had charge of all the drafting in connection with the mill's erection.

Received From the Trade.

The Acme Machinery Co. of Cleveland, O., in a catalogue of 120 pages, gives illustrations of the large line of bolt and nut machinery in the manufacture of which its business has expanded steadily in the past 15 years. The Acme bolt cutters and nut tappers were brought out in 1884, and since that time the works have been much enlarged. In the catalogue before us the construction of the Acme die head is given in detail, with sectional views illustrating the relation of the die ring, clutch ring and barrel to the remaining parts. The use of the Acme bolt cutter with lead screw attachment for bastard thread cutting is said to turn out work ten times as rapidly as an engine lathe. Many pages are given to the company's varied sizes and adaptations of bolt cutters and nut tappers.

Two interesting pamphlets come from the Chicago Fire Proof Covering Co. One, from its scientific department, discusses the oxidation of iron coated with various substances, and shows how by inductive methods of investigation galvanic elastic varnishes were found to have a protective value of 20, taking oil paint as the unit. Sixty reproductions of metal plates are given, demonstrating relative covering and presenting properties of various coatings. In the second pamphlet tests are given of the value of Chicago air cell asbestos and other substances for locomotive lagging and pipe covering.

American Engines in England.

Alfred Palmer, a civil engineer, writes to the *London Daily Mail* as follows: "I venture to predict that the introduction upon the Midland Railway of American locomotives will ultimately result in the much-desired central self-coupling buffers and bogie system of rolling stock, as now used throughout the United States and Canada. American locomotives, by having an elastic wheel base, are safer on the rails at high speeds than ours, being better able to adapt themselves to inequalities of line and surface; but since the material used by and the workmanship of our engineers cannot be excelled, we shall doubtless hear before very long of British firms receiving large orders from America for the 'Yankee' type of locomotive."

THE Federal Steel Co. has declared a dividend of 1½ per cent on the preferred stock.

LAKE SUPERIOR METHODS OF IRON MINING.*

BY DR. NELSON P. HULST.

Fewer modifications from early practice have been made in methods of hard ore mining than in methods of soft ore mining, since in the latter more or less timbering is required. It would be impossible, within the limits of this paper, to describe the mining methods of all the different mines of the several ranges. Choice has been made of describing the method pursued at the Soudan hard ore mines of the Minnesota Iron Co., as representing a sharp breaking away from the usual Lake Superior practice in the mining of hard ores. The magnitude of the soft ore mines on all the ranges (we include with them the Chandler and Pioneer mines, although their ores are in reality brecciated hard ores) has enlisted and tested the mining skill of many. For nearly a score of years there has been much experimenting on methods along different lines to work out some economical and safe plan of mining soft ores, and for each of the ranges methods have been settled on as best meeting the varying conditions found to exist in different ore bodies.

It may be explained here that more descriptions are given of methods of mining soft ores than are given of methods of mining hard ores because of more varied conditions attaching to them and because the soft ores have now grown to be the chief part of the Lake Superior ore product, constituting in 1898 more than 80 per cent of it.

The method of mining hard ore at the Soudan mine, on the Vermillion Range, has been well worked out. I am indebted for items in the description here given and for the drawings to a paper by D. H. Bacon, the president and manager of the Minnesota Iron Co. This was published in Vol. XXI. of the Transactions of the American Institute of Mining Engineers. The Soudan ore bodies have sometimes had a width of 80 feet and varying lengths of several hundred feet. They lie as lenticular masses enclosed between locally-called greenstone rocks constituting the walls. They dip at a steep angle. Often they are friable and quite frequently treacherous. In the early mining the ore was quarried from open pits to the depth of 100 feet or more. For greater depth it became necessary to resort to underground mining. Shafts are located in the foot wall, as shown in Fig. 1, Plate No. 1. At intervals of 75 feet, crosscuts are driven into and across the ore body, as shown on this plate. From each of these crosscuts a chamber is mined out, 20 feet high in the ore. These chambers to the several crosscuts are shown in elevation on Plate 1. They are shown in plan on Fig. 2, Plate 2. Their longitudinal elevation is also shown on this plate, in Fig. 1. The chamber of a level is made to extend on either side of the crosscut as far as the character of walls of green stone, or chloritic rock, will permit. From the mouth of the crosscut, where it opens into an excavated chamber, the timber-work for a crosscut is extended well into the excavated chamber. This timber-work is well shown in elevation in Fig. 1, Plate 1, and in plan in Fig. 2, Plate 2. The timber-work for longitudinal drifts is erected in these excavated chambers. As shown in plan on Fig. 2, Plate 2, they extend from the timbered crosscuts right and left. The timber-work of raises is also erected alongside of the drift timbering just described. These are seen in plan in Fig. 2, Plate 2, and in elevation on seventh level in Fig. 1, Plate 1.

The timbered raises extend two to five feet above the timber-work of the drifts they are connected with. Other timbered raises are erected for ladder-ways. Still other raises are made to connect with the mine workings. These raises are in the wall rocks, either foot or hanging, according to requirements. These raises in the wall rocks are used for rock chutes. Through them rock from the open pit, near the surface, is brought down to any level required. These rock chutes are seen in plan in Fig. 2, Plate 2, and in elevation in Fig. 2, Plate 1. After the timber-work of crosscut, drifts and raises, in an excavated chamber, have been completed, then rock from the open pit above is run down through the rock chutes and filled around and over the timber-work just mentioned, covering the drifts and crosscuts to the depth of three or four feet. The excavated chamber is further extended right and left by stoping away 20 feet of ore above the level, from

* Read before the Engineers' Society of Western Pennsylvania, at Pittsburg, Feb. 21, 1899.

wall to wall. The timber-work of drifts is extended. The necessary timber-work of raises for the lengthened drifts is completed. Stoping upward, i. e., back stoping, is begun above the filling by blasting down 10 feet or more of ore from above and from wall to wall and as far as the filling over the timbering extends. This is shown in the longitudinal section in Fig. 1, Plate 2. The ore broken down on the filling is passed down to tram cars on the level below by the chutes described. After all this broken ore has been removed through the chutes, the chutes are built up to a proper height and filling of rock is repeated as before. The stoping on the level is also repeated and timber work of drifts and raises erected in the extended chamber. Stoping, removing broken ore through the chutes, timbering and rockfilling succeed one another until the level is nearly exhausted of ore. A roof of ore is of necessity left to support the rock-filling of the level above. In the upper levels, this roof of ore was successfully removed by back-stoping during winter, after the filling had become thoroughly frozen. At lower levels, where the frost could not well penetrate, this winter removal of ore could not be made. The roof was there left thick enough for drifts to be driven in it. It was first caved down on the filling of the level below and then won by drifting and cross-cutting, which was not difficult in the broken ore.

System of Mining at Chapin Mine.

Several systems of mining have been practiced at the Chapin mine on the Menominee Range. The manager of this mine has kindly favored me by having his engineer

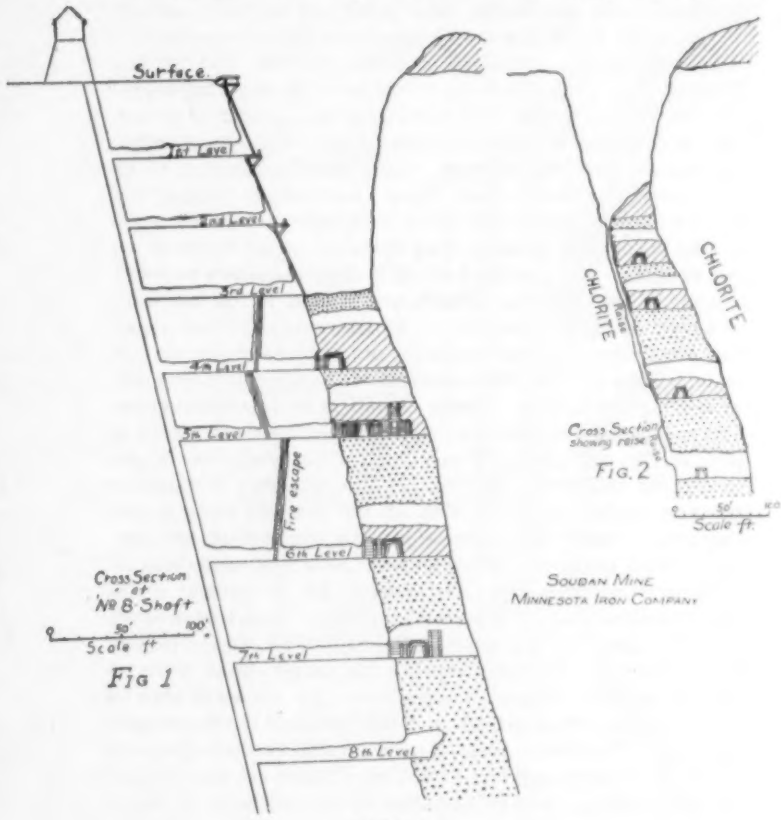


PLATE 1.

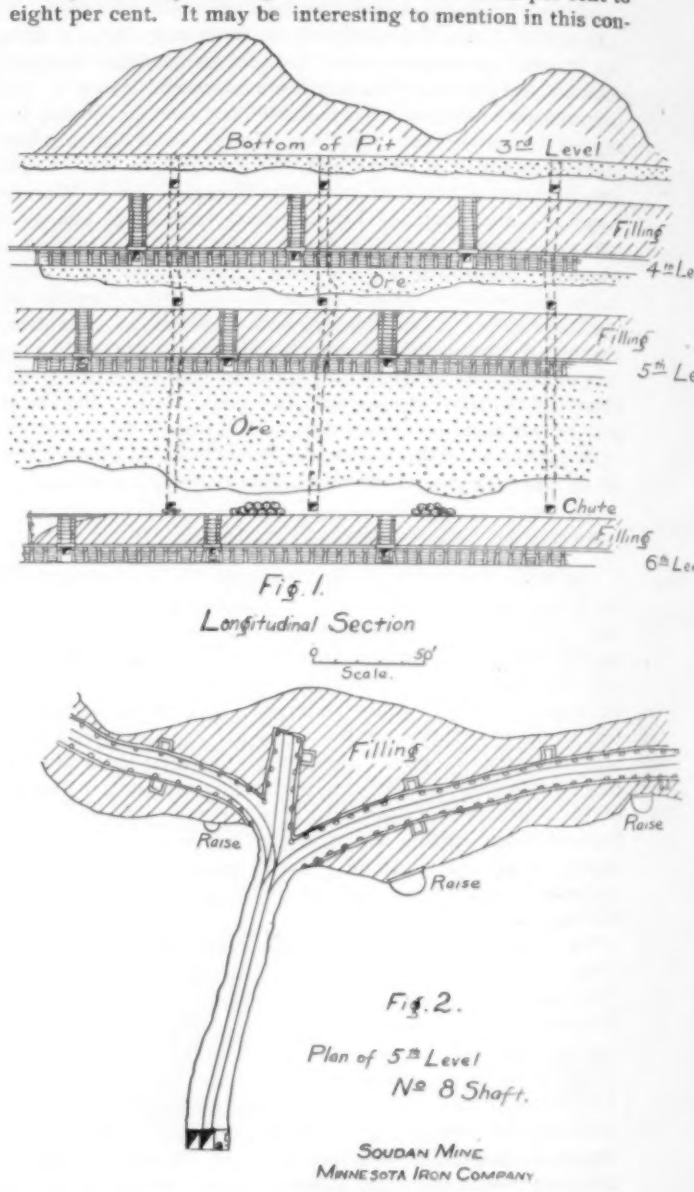


PLATE 2.

furnish me with the following, which covers the various methods which have been used and which at present are in operation there.

The ore bodies of the Chapin mine which are lenticular in form and vary from a few hundred to over 2,000 feet in length, with a width of 20 to 140 feet, dip to the north at an angle of about 70 degrees from the horizontal and have a westerly pitch of about 45 degrees. The foot wall is a chlorite schist, locally called "slates," about 100 feet thick, which in turn has a hard jaspillite foot wall. Near the ore body the schist is very much decomposed and of an extremely soft and friable nature. As the jaspellite is neared the schist grows stronger and harder, and gradually becomes more quartzose, until the line of demarkation between the two is indistinct.

The hanging wall is also a chloritic schist having much the same characteristics as the foot wall schist; i.e., near the ore it is soft, friable and broken up and of a very slippery nature. In the extreme ends of the lenses, where the ore is narrow and so hard that it is necessary to use machine drills to drive the drifts, the openings are subjected to excessive lateral pressure, due to the unstability of the foot and hanging walls. The legs of the setts are buckled inward on both sides of the drift while the caps remain intact, showing that the pressure is a squeezing from both foot and hanging, rather than a vertical pressure due to the weight of the ore undercut. Openings in the ore do not show this peculiarity, indicating that the ore is more stable; in fact, the ore is hard enough to require machine drills for all development work. We have then an ore body of a fairly stable nature and a foot and hanging of an extremely unstable character. Although, in common with a majority of the larger mines on the Menominee Range, there is a large amount of water in the ore formation, the ore drains readily and the percentage of moisture is from six per cent to eight per cent. It may be interesting to mention in this connection that something over six tons of water are raised for each ton of ore raised at the Chapin mine.

It was first attempted to extract the ore on stulls, but the ore body soon became so wide that the room and pillar system was tried. This consisted of taking rooms 20 feet wide and from foot to hanging, leaving pillars 18 feet wide. The rooms were not filled, but were timbered with square setts, such as are usually used in this style of mining. The sudden caving in of several of these rooms, due to the unstable foot and hanging, and possibly also to the weight of sand and boulders lying on the ore, taught that this system was not practicable. Then the plan of filling the rooms with sand and with rock quarried for that purpose was tried. It was found there was a settling of the surface and as many tracks, buildings, trestles, etc., were located immediately over the ore, it was desired those should remain undisturbed by any subsidence of the surface. After the rooms had been worked out and filled down to the sixth level, it was found the pillars were

crushing and an attempt was made to remove them and still support the surface by the slicing and filling system. Fig. 2 of Plate 3 is a plan showing foot wall level, chutes, crosscuts and longitudinal slices. The arrow points indicate the direction in which the openings were driven. Fig. 3 of Plate 3 is a vertical cross section through two levels showing the foot wall levels, winze for running the filling down to the slices, crosscuts, chutes for running the ore down to the levels and another tier in process of being worked out and filled, and another tier in the process of being worked out. As shown, levels were driven in the foot wall, and opposite each pillar raises were put high enough for a chute and crosscuts driven out to and through the ore to the hanging. From these crosscuts 7-ft. x 7-ft. longitudinal slices were driven to the limits of the block of ground. As soon as the first slice on the hanging was completed, it was filled, the men were brought back and another slice started alongside the first. This method was pursued until the whole block of ground was undercut and filled. An additional 7 feet was added to the height of the raise, the back of the original crosscut in the rock was stoped down and the rock thrown under foot, so the rock formed the floor of the new crosscut which was extended to the hanging and slices were driven and filled in the manner described above; the filling in the last tier of slices forming the floor of the new crosscuts and slices. This process was system down to the eleventh level. Necessity of keeping up the production was the chief reason for doing this, which could only be done in this way as it took considerable time to demonstrate the feasibility of the caving system and to open up the ground preparatory to its general adoption. In applying the caving system to the taking out of the pillars after the rooms are filled, the following method is pursued. See Fig. 6, Plate 3:

The levels are driven about in the center of the ore, 100 feet apart vertically. For the sake of illustration, suppose the ore has been taken out down to the seventh level and it is desired to mine the lift between the seventh and eighth levels. From the eighth level two compartment raises, five feet by seven feet, are put up to the seventh level. The seventh level is kept open as long as possible, chiefly to provide getting timber down to the crosscuts, drifts and slices. It sometimes happens that all of the preceding level has to be abandoned and in that case timber has to be pulled up from the level below by hand, which is a slow, laborious and expensive process. Consequently this is avoided as much as possible. The height of back that can be most advantageously handled at the Chapin mine has been demonstrated to be about eight feet. After the raises are up to the seventh level, a crosscut, 7 ft. x 7 ft., is driven 15 feet below the level to both foot and hanging and timbered with light timber, locally called "slice setts." Top

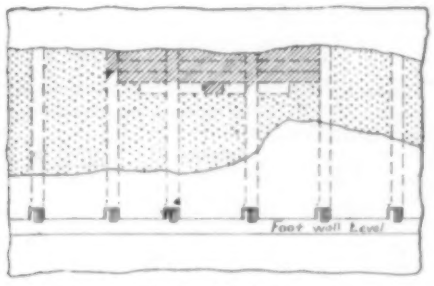


Fig. 2 Slicing System

SLICING AND SUB-DRIFT CAVING SYSTEM.
CHAPIN MINE.

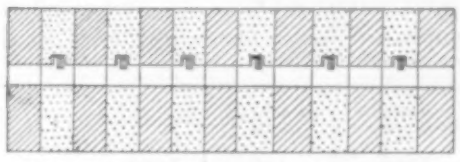


Fig. 4 Caving System. Plan showing filled rooms, pillars, raises, level, etc.

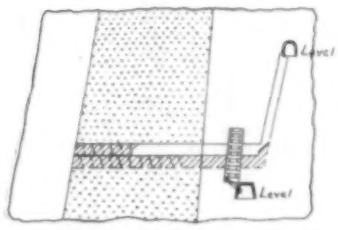


Fig 3 Slicing System

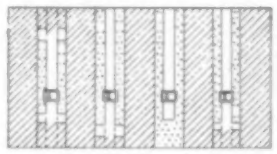


Fig 5 Caving System Plan showing filled rooms Cross cuts in pillars Location of chutes Longitudinal slices etc.

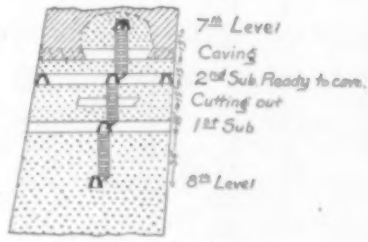


Fig. 6 Sub-drift caving system

PLATE 3.

continued until the lift was worked out. It was found there was still a settling of the surface; consequently all the attempts to sustain the same were abandoned and the tracks and buildings were moved.

"Settling" and "Caving" Systems.

The filling of the slices was abandoned and on the fourth, fifth and sixth levels the pillars were undercut in substantially the same manner described above, the timber, which was light, blasted out when necessary, and the pillar allowed to settle the distance of the height of the slice. This was called the "settling system" and it worked satisfactorily in the ground just referred to which was soft and crushed, as many as seven slices being taken on the same rails, but upon attempting to apply it to ground on the seventh level, which was harder and had not been crushed, it was found the pillars broke up in large masses when undercut and allowed to settle. These masses were too large to handle without block holing and blasting and were so heavy the timber in the slices were broken too soon, which showed there was too much weight in the ground undercut. This led to the adoption of what is known as the "caving system," which is essentially the same as the settling system with the modification that the thickness of the back is decreased to suit the conditions obtaining. In the meantime, rooming and filling had been continued, and before the caving system had been extended to all parts of the mine, the mine had been opened up on this lagging only is used. When the foot is reached, the miners begin to take off successive longitudinal slices, timbering only enough to protect themselves from the back. The weight of the overlying debris crushes the back which soon begins to come down with the help of an occasional stick of dynamite, and the process of "robbing back" is in full operation. When the miners get within a couple of slices of the raise they begin slicing on the hanging side in the same manner, the slices nearest the raise being the last taken. In the meantime another party of men has been driving a crosscut immediately under and 15 feet below the first. As soon as the first floor is caved, caving is begun on the second and so on down to the eighth level. It occasionally happens that two parties will be caving while a third is "cutting out," but as a general rule two gangs of two men each on each shift are all that are worked in a pillar. Any ore that fails to come down on any lift is obtained on the next. After the ground is cut out, all machine drills and air pipes are removed and the miners put in their holes with hand drills and jumpers. When they have machine drills, they have a tendency to put in too deep holes and cave too much ground and threby leose control of it.

There are no large openings, and the roof and sides of the working places are at all times close to the miners, which permits of frequent careful examinations both by the workmen and the bosses. The crushing of the ore by the weight of the debris lessens the amount of powder used and also the labor necessary to break the ore. From 30 to 50 per cent of the ore mined is obtained without the use of powder.

[To be continued.]

First Results of A. F. A. Tests.

The comprehensive program and the thoroughgoing work of the American Foundrymen's Association's committee on a Standard System of Test Bars for Cast Iron have been referred to in these columns several times in the past eight months. We are glad to be able to present herewith a memorandum from Dr. Richard Moldenke, chairman of the committee, relative to the first series of test bars and the results of the physical tests. The memorandum and the test tables are as follows:

TABLE 1.—*Transverse Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in green sand and not machined.

No.	Approx. Cross Section. Inches.	Actual Size Depth. Inches.	Actual Size Width. Inches.	Breaking Strain. Lbs.	Deflection. Inches.	Contraction Inches.
1		.56	.56	310	.165	
2	.5 x .5	.56	.56	320	.150	.17 in 12
3		.56	.57	300	.140	
4		.56	.59	300	.145	
5	1 x 1	1.09	1.06	1,980	.125	.14
6		1.10	1.03	2 050	.130	
7	1.5 x 1.5	1.53	1.53	6,720	.110	.12
8		1.54	1.53	6,450	.115	
9	2 x 2	2 06	2.04	14,050	.098	.08
10		2.02	2.04	13,820	.095	
11	2.5 x 2.5	2.53	2 69	25 670	.090	.08
12		2.57	2.00	26,580	.099	
13	3 x 3	3.01	3.04	43,110	.098	.06
14		3.03	3.02	38,880	.089	
15	3.5 x 3.5	3.59	3.59	56,600	.098	.04
16		3.57	3.57	60,840	.097	
17	4 x 4	4.09	4.11	42,020	.099	.03
18		4.08	4.07	87,920	.083	

TABLE 2.—*Transverse Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in green sand and machined.

No.	Approx. Original Cross Section. Inches.	Actual Size as Machined. Inches	Breaking Strain. Lbs.	Deflection. Inches.
19	1 x 1	.5 x .5	310	.321
20			290	.332
21	1.5 x 1.5	1 x 1	1,570	.211
22			1,690	.234
23	2 x 2	1.5 x 1.5	5,960	.171
24			5,730	.153
25	2.5 x 2.5	2 x 2	13,290	.134
26			12,520	.118
27	3 x 3	2.5 x 2.5	23,770	.122
28			23,080	.129
29	3.5 x 3.5	3 x 3	34,380	.121
30			38,270	.121
31	4 x 4	3.5 x 3.5	50,040	.112
32			53,320	.102

TABLE 3.—*Transverse Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in dry sand and not machined.

No.	Approx. Cross Section. Inches.	Actual Size. Depth. Inches.	Actual Size. Width. Inches	Breaking Strain. Lbs.	Deflection. Inches.	Contraction Inches.
33		.56	.59	250	.175	
34	.5 x .5	.57	.55	280	.195	.17 in 12
35		.56	.54	280	.160	
36		.56	.52	240	.150	
37	1 x 1	1.08	1.03	1,910	.140	.14
38		1.09	1.02	1,780	.135	
39	1.5 x 1.5	1.48	1 50	6,090	.120	.11
40		1.56	1.49	5 920	.109	
41	2 x 2	2.00	2.03	11,810	.103	.08
42		2.09	1.98	11,980	.118	
43	2.5 x 2.5	2.49	2.64	21,340	.097	.07
44		2.53	2.58	22,640	.105	
45	3 x 3	3.03	3.00	33,130	.106	.06
46		3.06	3.01	32,440	.105	
47	3.5 x 3.5	3.64	3.60	54,120	.092	.03
48		3.62	3.61	53,700	.081	
49	4 x 4	4.13	4.10	77,020	.079	.02
50		4.21	4.04	76,000	.086	

Cast A— Ingot Mold Iron, Soft Bessemer Mixture.

This set of 192 bars, cast vertically and at the same time, in accordance with the specifications of the American Foundrymen's Association Committee on Standardizing the Testing of Cast Iron, furnished 256 test pieces and 280 separate tests. These test bars were made by Mr. Thos. D. West and presented to the committee in the interest of the trade.

Cast A illustrates an "all pig iron" class of castings of

TABLE 4.—*Transverse Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in dry sand and machined.

No.	Approx. Original Cross Section. Inches.	Actual Size as Machined. Inches.	Breaking Strain. Lbs.	Deflection. Inches.
51	1 x 1	.5 x .5	270	.311
52			260	.318
53	1.5 x 1.5	1 x 1	1,700	.251
54			1,720	.244
55	2 x 2	1.5 x 1.5	5,050	.162
56			4,890	.180
57	2.5 x 2.5	2 x 2	11,110	.129
58			11,170	.128
59	3 x 3	2.5 x 2.5	18,780	.126
60			19,090	.129
61	3.5 x 3.5	3 x 3	32,120	.119
62			30,450	.118
63	4 x 4	3.5 x 3.5	46,260	.112
64			46,170	.113

TABLE 5.—*Transverse Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in green sand and not machined.

No.	Approx. Diameter. In. diam.	Actual Size. Depth. Diameter. Inches.	Actual Size. Width. Diameter. Inches.	Breaking Strain. Lbs.	Deflection. Inches.	Contraction Inches.
65*		.60	.56			
66*		.62	.57			
67	.56	.62	.56	430	.170	.16 in 12
68		.62	.58	460	.175	
69	1.13	1.22	1.19	2,650	.120	.14
70		1.21	1.18	2,230	.141	
71	1.09	1.81	1.84	6,840	.140	.12
72		1.77	1.70	6,010	.132	
73	2.15	2.29	2.27	13,760	.101	.10
74		2.33	2.30	14,170	.118	
75	2.82	2.93	2.87	24.040	.095	.07
76		2.96	2.90	24,600	.108	
77	3.38	3.44	3.44	36,780	.102	.07
78		3.46	3.44	36,970	.109	
79	3.95	4.02	4.04	54,950	.086	.05
80		4.00	4.01	61,920	.095	
81	4.51	4.67	4.62	75,210	.083	.03
82		4.65	4.64	79,500	.094	

* Porous.

TABLE 6.—*Transverse Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in green sand and machined.

No.	Approx. Original Diameter. Inches, diam.	Actual Size as Machined. Inches, diam.	Breaking Strain. Lbs.	Deflection. Inches.
83	1.13	.56	150	.305
84*				
85	1.69	1.13	1,910	.244
86			1,850	.225
87	2.15	1.69	5,650	.163
88			5,210	.158
89	2.82	2.15	10,010	.110
90			10,040	.118
91	3.38	2.82	18,890	.082
92			19,410	.088
93	3.95	3.38	29,650	.070
94			29,090	.074
95	4.51	3.95	50,310	.075
96			53,350	.083

* Lost in turning down.

fairly soft character which must also show exceptional service qualities under severe sudden heating or cooling effects, causing alternate expansion and contraction strains in castings.

TABLE 7.—*Transverse Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in dry sand and not machined.

No.	Approx. Diameter. In. diam.	Actual Size. Depth. Inches.	Actual Size. Width. Inches.	Breaking Strain. Lbs.	Deflection. Inches.	Contraction Inches.
97	.56	.62	.52	220	.225	.16 in 12
98		.62	.63	220	.220	
99		.63	.62	230	.225	
100		.58	.55	210	.220	
101	1.13	1.20	1.18	1,870	.155	.14
102		1.14	1.20	1,720	.135	
103	1.69	1.75	1.73	6,030	.130	.11
104		1.75	1.74	5,750	.126	
105	2.15	2.26	2.23	11,980	.108	.09
106		2.28	2.22	11,730	.104	
107	2.82	2.91	2.88	22,450	.108	.06
108		2.98	2.87	21,620	.102	
109	3.38	3.40	3.38	34,070	.091	.06
110		3.39	3.37	33,520	.089	
111	3.95	4.06	3.97	51,950	.087	.04
112		4.03	4.02	47,790	.081	
113	4.51	4.62	4.63	71,990	.060	.03
114		4.64	4.61	74,890	.060	

TABLE 8.—*Transverse Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in dry sand and machined.

No.	Approx. Original Cross Section. Inches, diam.	Actual Size as Machined. Inches, diam.	Breaking Strain. Lbs.	Deflection. Inches.
115	1.13	.56	160	.260
116			160	.250
117	1.69	1.13	1,730	.236
118			1,860	.260
119	2.15	1.69	5,130	.165
120			5,070	.168
121	2.82	2.15	9,000	.138
122			9,190	.123
123	3.38	2.82	20,690	.081
124			21,370	.085
125	3.95	3.38	28,050	.075
126			28,650	.069
127	4.51	3.95	46,860	.068
128			45,620	.063

TABLE 9.—*Tensile Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in green sand and not machined.

No.	Approximate Cross Section. Inches.	Actual Area in Square Inches.	Breaking Strain. Lbs.	Ultimate Strength per Square Inch. Lbs.
129	.5 x .5	.22	3,620	16,450
130		.21	3,280	15,620
131		.27	4,110	15,220
132		.29	4,680	16,140
133	1 x 1	1.00	15,200	13,940
134		.92	12,810	13,920
135	1.5 x 1.5	2.33	29,210	12,530
136		2.28	26,790	11,750
137	2 x 2	3.98	40,380	10,190
138		4.04	44,870	11,110
139	.5 x .5	.31	4,620	14,900
140		.28	4,510	16,100
141		.31	4,980	16,040
142		.30	4,570	15,230
143	1 x 1	.90	13,610	13,070
144		1.00	13,420	13,420
145	1.5 x 1.5	2.30	27,780	12,080
146		2.59	25,120	10,970
147	2 x 2	4.00	42,520	10,630
148		3.97	38,990	9,820

The composition of this cast as taken from the 1-inch dry sand square bar is as follows:

Total carbon	3.87
Graphite	3.44
Silicon	1.67
Manganese	.29
Phosphorus	.095
Sulphur	.032

TABLE 10.—*Tensile Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in green sand and machined.

No.	Approx. Original Cross Section. Inches.	Area as Machined, in Square Inches.	Breaking Strain. Lbs.	Ultimate Strength per Sq. In. Lbs.
149	1 x 1	.25	3,770	15,080
150		.25	3,940	15,760
151	1.5 x 1.5	1.00	12,860	12,860
152		1.00	13,020	13,020
153	2 x 2	2.25	25,900	11,510
154		2.25	23,360	10,380
155	1 x 1	.25	3,620	14,480
156		.25	3,840	15,360
157	1.5 x 1.5	1.00	12,410	12,410
158		1.00	14,640	14,640
159	2 x 2	2.25	24,480	10,880
160		2.25	26,510	11,780

TABLE 11.—*Tensile Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in dry sand and not machined.

No.	Approximate Cross Section. Inches.	Actual Area in Square Inches.	Breaking Strain. Lbs.	Ultimate Strength per Square Inch. Lbs.
161	.5 x .5	.27	3,910	14,410
162		.24	3,740	15,580
163		.20	2,620	13,100
164		.25	3,800	15,200
165	1 x 1	.94	12,450	13,140
166		.95	12,120	12,760
167	1.5 x 1.5	2.38	30,140	12,660
168		2.25	28,000	11,910
169	2 x 2	3.90	37,140	9,520
170		3.96	39,880	10,070
171	.5 x .5	.31	4,320	15,550
172		.28	4,510	16,110
173		.30	4,980	16,600
174		.30	4,570	15,230
175	1 x 1	1.00	13,440	13,440
176		1.01	12,840	12,710
177	1.5 x 1.5	2.40	27,310	11,380
178		2.42	30,540	12,620
179	2 x 2	4.00	41,390	10,350
180		4.00	43,000	10,750

TABLE 12.—*Tensile Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in dry sand and machined

No.	Approx. Original Cross Section. Inches.	Area as Machined, in Square Inches.	Breaking Strain. Lbs.	Ultimate Strength per Sq. In. Lbs.
181	1 x 1	.25	3,620	14,480
182		.25	3,300	13,200
183	1.5 x 1.5	1.00	12,990	12,990
184		1.00	13,850	13,850
185	2 x 2	2.25	27,060	12,030
186		2.25	27,480	12,210
187	1 x 1	.25	3,000	12,000
188		.25	3,240	12,960
189	1.5 x 1.5	1.00	12,840	12,840
190		1.00	13,140	13,140
191	2 x 2	2.25	24,540	10,910
192		2.25	26,100	11,600

The cross section of the square bars and the round is approximately equal for the respective sizes. The machine bars were turned or planed to the size below for purposes of comparison. In the transverse tests the supports were all 12 inches apart.

The fresh fracture of each size of round and square, green sand and dry sand transverse bar was preserved, mounted in a case, and will be on exhibition at the May convention of the American Foundrymen's Association, in Pittsburg. From the physical structure of these bars it is seen that the largest sizes for this particular kind of iron will not answer for either the standard tensile or transverse test, evidences of shrinkage spots being discernible.

But two of the smallest bars of this cast proved unserviceable, which is certainly a good showing for the method adopted. The fluidity strips ran up full, showing good hot iron. The chilled fractures are shown in the cut accompanying the table.

The tabulated results of the transverse, tensile and compression tests appear herewith and are given for the present without further comment, the committee deeming it wise to publish the results as fast as they are available and reserving the discussion for their final report.

TABLE 13.—*Tensile Strength.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in green sand and not machined.

No.	Approximate Cross Section. Inches.	Actual Area in Square Inches.	Breaking Strain. Lbs.	Ultimate Strength per Square Inch. Lbs.
193	.5 x .5	.25	3,780	15,120
194		.26	4,340	16,690
195		.30	4,900	16,330
196		.25	3,980	15,920
197	1 x 1	.98	13,290	13,560
198		1.00	13,980	13,980
199	1.5 x 1.5	2.30	30,560	13,290
200		2.31	27,140	11,750
201	2 x 2	4.10	47,310	11,540
202		4.00	42,360	10,590
203	.5 x .5	.28	4,050	14,460
204		.30	4,890	16,300
205		.31	4,890	15,770
206		.31	4,140	13,320
207	2 x 1	1.00	12,830	12,830
208		1.00	12,740	12,740
209	1.5 x 1.5	2.26	25,410	11,240
210		2.27	28,320	12,480
211	2 x 2	3.96	40,920	10,330
212		4.00	44,040	11,020

TABLE 14.—*Tensile Strength.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in green sand and machined.

No.	Approx. Original Cross Section. Inches.	Area as Machined, in Square Inches.	Breaking Strain. Lbs.	Ultimate Strength per Sq. In. Lbs.
213	1 x 1	.25	3,510	14,040
214		.25	3,370	13,480
215	1.5 x 1.5	1.00	13,070	13,070
216		1.00	13,910	13,910
217	2 x 2	2.25	26,270	11,670
218		2.25	28,780	12,790
219	1 x 1	.25	3,650	14,600
220		.25	3,340	13,360
221	1.5 x 1.5	1.00	11,840	11,840
222		1.00	12,970	12,970
223	2 x 2	2.25	23,040	10,240
224		2.25	25,170	11,190

TABLE 15.—*Tensile Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in dry sand and not machined.

No.	Approximate Cross Section. Inches.	Actual Area in Square Inches.	Breaking Strain. Lbs.	Ultimate Strength per Square Inch. Lbs.
225	.5 x .5	.24	3,120	13,000
226		.27	4,030	14,920
227		.25	3,620	14,480
228		.21	3,090	14,710
229	1 x 1	1.01	14,220	14,080
230		1.00	13,370	13,370
231	1.5 x 1.5	2.26	25,900	11,460
232		2.22	26,450	11,910
233	2 x 2	4.00	40,840	10,210
234		4.01	43,510	10,850
235	.5 x .5	.31	5,050	16,290
236		.30	4,560	15,200
237		.26	4,080	15,690
238		.25	3,830	15,320
239	1 x 1	.99	13,390	13,530
240		1.00	12,910	12,910
241	1.5 x 1.5	2.30	28,240	12,280
242		2.34	25,010	10,690
243	2 x 2	4.07	42,260	10,380
244		4.04	40,040	9,900

TABLE 16.—*Tensile Test.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture. Bars in dry sand and machined.

No.	Approx. Original Cross Section. Inches.	Area as Machined, in Square Inches.	Breaking Strain. Lbs.	Ultimate Strength per Sq. In. Lbs.
245	1 x 1	.25	3,420	13,650
246		.25	3,380	13,520
247	1.5 x 1.5	1.00	12,440	12,440
248		1.00	14,010	14,010
249	2 x 2	2.25	22,860	10,160
250		2.25	24,900	11,070
251	1 x 1	.25	3,690	14,760
252		.25	3,010	12,040
253	1.5 x 1.5	1.00	12,140	12,140
254		1.00	13,450	13,450
255	2 x 2	2.25	22,260	9,890
256		2.25	27,020	12,010

TABLE 17.—*Compression Tests on ½-inch Cubes.*

SERIES A.—Ingot Mold Iron. Soft Bessemer Mixture.

No.	Approximate Cross Section of Bar. Inches.	Crushing Strength in Pounds. Middle ½ Inch.	First ½ Inch from Edge.	Second ½ Inch from Edge.	Third ½ Inch from Edge.	Fourth ½ Inch from Edge.	Remarks.
257	.5 x .5	29,570					The cubes were cut from the square bars cast in dry sand (vertically), and were compressed along the length of the original bar. The test pieces were cut along lines at right angles to the sides of the bar, so that all corners were avoided except in the ½-inch bar. For better comparison the value of the middle cube is repeated in the table where it rounds out the series for the particular bar.
258	1 x 1	20,010					
259			21,990				
260	1.5 x 1.5	17,180		17,180			
261			17,920				
262	2 x 2	13,810					
263			13,750				
264				13,880			
265	2.5 x 2.5	10,950			10,950		
266			12,040				
267				11,430			
268	3 x 3	9,830					
269			11,200				
270				10,270			
271					10,430		
272	3.5 x 3.5	9,350				9,350	
273			10,770				
274				9,830			
275					9,540		
276	4 x 4	9,100					
277			10,340				
278				9,950			
279					9,570		
280						9,360	

THE Pressed Steel Car Co. has just concluded negotiations for a site for its new plant, a tract of 120 acres of land at McKees Rocks, Pa., having been purchased at about $3,000 an acre. The land has a good river frontage on the Ohio River, and the plant will be connected with the Pittsburg & Lake Erie and the Pittsburg, Chartiers & Youghiogheny roads, the latter running back into the country at this place and connecting with the Pan Handle division of the Pennsylvania system.

THE Roane Iron Co., of Chattanooga, Tenn., will spend $200,000 in a new blast furnace at Rockwood, Tenn. Work will begin in May. New ore lands will be opened up.

ANALYSES OF LAKE SUPERIOR ORES.

Compilation has just been completed by the association of Lake Superior iron ore producers, of the analyses of ores shipped from Lake Superior mines in 1898. In the main the average of cargo analyses of the shipments of last season are taken—both Bessemer and non-Bessemer ores. Exceptions to this rule are indicated in the table below by the asterisk after the name of the ore. In all such cases the analysis given is that which the ore is expected to average in the coming season:

GOGEBIC RANGE.

ORE.	IRON, Natural State.	DRIED AT 212° FAHRENHEIT. IRON.	SILICA.	PHOS.	MANG.	ALUMINA	LIME.	MAG. MESIA.	SULPH.	ORE A VOL.	MOIST.
Atlantic	55.63	62.89	4.79	.047	.86	1.49	.18	.15	.021	3.25	11.54
Ashland	55.44	63.19	3.96	.056	.25	2.21	.21	.15	.015	3.00	12.27
Aurora	55.35	61.34	6.72	.028	.40	1.02	.37	.11	.018	4.12	9.77
Buckeye	53.08	59.44	8.40	.071	.423	1.526	.24	.286	.013	4.76	10.70
Best	50.34	58.00	10.25	.0618	.81	1.63	.31	.16	.013	3.28	13.20
Brotherton *	55.60	63.00	7.20	.035	.47	.87	.21	.04	.018	1.60	11.74
Cary Empire	52.90	58.21	3.22	.059	4.50	.80	.27	.14	None.	5.80	8.96
Colby No. 1	51.58	58.70	3.20	.066	6.829	.886	.160	.460	.006	2.200	9.02
Colby No. 2	54.66	60.80	4.00	.080	2.25	1.16	.17	.47	.008	2.15	9.80
Day	56.80	63.58	3.11	.078	.5319	.....	.....	.....	.....	.....	10.67
Fairfax	55.24	64.06	3.60	.0738	.9915	.....	.....	.....	.....	.....	13.76
Globe	55.20	62.02	3.93	.095	.21	1.70	.35	.15	.010	3.25	11.00
Iron Belt	53.74	60.75	8.09	.041	.40	1.21	.11	.18	.024	3.09	11.54
Lawrence	54.04	62.26	5.64	.059	.552	1.138	.11	.135	.006	2.86	10.02
Malcom *	55.39	62.00	4.92	.020	1.11	.81	.07	.10	.018	3.90	10.66
Montreal	50.56	56.00	2.31	.040	.36	.75	.23	.09	.007	1.80	8.24
Newport No. 1	48.71	54.05	4.60	.067	6.01	1.30	.15	.07	.006	5.80	9.87
Newport No. 2 *	45.00	50.00	.....	.035	6.00	.....	.....	.....	.....	.....	10.00
New Era *	50.80	57.00	12.15	.026	1.26	1.06	.47	.11	.005	3.50	10.87
Norrona (Palms)	53.94	62.00	4.61	.086	.84	1.29	.23	.17	.014	3.67	13.00
North Vein	56.29	62.37	4.10	.046	.540	.880	.020	.090	.004	2.240	9.75
Norrie	56.56	63.68	.....	.0388	.3388	.....	.....	.....	.....	.....	10.34
Palms	52.93	62.95	3.94	.055	.90	1.17	.16	.14	.017	3.53	14.34
Sand	52.74	58.57	5.25	.026	3.21	1.07	.68	.60	.017	.....	9.95
Shores	58.87	64.28	3.30	.029	.30	.75	.18	.11	.004	1.12	8.42
Tilden	54.83	63.43	.....	.046	1.0902	.....	.....	.....	.....	.....	13.86
Toronto	44.83	49.60	26.00	.045	.45	1.25	.40	.25	.015	.....	8.60

MENOMINEE RANGE.

ORE.	IRON, Natural State.	DRIED AT 212° FAHRENHEIT. IRON.	SILICA.	PHOS.	MANG.	ALUMINA	LIME.	MAG. MESIA.	SULPH.	ORE A VOL.	MOIST.
Aragon	59.10	65.34	4.39	.086	.14	1.01	.89	1.84	.007	1.28	6.54
Amen	53.34	56.90	6.98	.267	.35	3.35	1.90	1.74	.014	4.90	6.75
Badger	54.21	59.73	4.18	.146	1.493	2.73	1.10	3.23	.075	2.70	9.24
Bristol *	52.06	56.60	3.75	.80	1.75	1.10	3.60	1.50	.030	.....	7.00
Chapin *	57.39	61.60	4.96	.065	.32	1.15	.61	2.20	.012	2.27	6.34
Clifford	39.42	40.44	39.19	.016	.11	.85	.51	.28	.002	.70	2.51
Columbia	53.40	60.00	3.78	.550	.23	1.99	.41	.80	.160	.....	11.06
Crystal Falls	53.62	58.80	4.45	.705	.20	1.41	2.40	.93	.008	2.140	8.50
Davidson	51.37	56.89	6.25	.166	.395	3.12	1.50	3.49	.114	3.90	8.90
Dunn	52.06	58.00	4.00	.562	.74	1.96	1.72	.81	.021	6.22	9.20
Elmwood	53.14	58.16	5.69	.165	.331	2.804	1.18	2.317	.055	4.62	8.63
Florence	51.62	56.10	4.79	.308	.31	2.18	1.17	1.92	.271	5.67	7.98
Great Western	56.15	61.20	4.60	.375	.24	1.16	2.10	.60	.006	3.10	8.40
Grenada	57.80	62.42	4.56	.062	.16	1.02	.54	1.00	.017	1.70	7.40
Hemlock	58.68	59.43	5.08	.232	.14	2.23	2.10	1.75	Trace	2.33	4.82
Keel Ridge *	39.46	40.64	37.42	.046	.20	.90	1.35	1.00	.006	1.50	2.90
Lament *	52.70	57.00	4.15	.72	.24	1.34	2.61	1.10	.006	2.10	8.50
Lords	54.80	63.48	3.74	.152	.137	1.15	.94	1.67	.003	1.05	7.37
Lincoln *	56.85	62.20	4.70	.425	.320	1.070	1.420	.720	.010	2.840	8.60
Loretto	53.13	58.50	9.80	.019	.24	1.92	.32	.20	.139	2.66	9.17
Meriden	58.23	61.76	2.20	.55	.16	2.40	.70	.20	.085	5.10	5.75
Millie	59.75	63.21	2.54	.027	.29	.93	1.14	1.74	.009	2.51	5.48
Nimick *	58.05	62.68	4.37	.078	.17	1.05	.64	1.62	.013	1.68	7.39
Perabie *	58.90	63.59	4.32	.012	.13	1.05	.91	1.22	.002	1.46	7.38
Perabie Genna	42.14	44.00	32.80	.007	.09	1.10	.79	1.07	.005	1.18	4.22
Rex	53.51	57.54	6.25	.068	1.08	1.52	1.34	2.93	.018	3.36	7.00
Rowell *	52.40	56.35	6.72	.065	.30	2.21	2.27	3.48	.053	3.78	7.00
San Jose	60.62	65.51	3.46	.0135	.55	1.14	.79	.25	.026	.72	7.47
Star	58.02	62.29	4.80	.065	.31	1.35	.92	1.51	.007	1.95	6.86
Toledo	50.61	54.66	18.23	.010	.18	.65	1.39	1.57	.003	.....	6.28

MARQUETTE RANGE.

ORE.	IRON, Natural State.	DRIED AT 212° FAHRENHEIT. IRON.	SILICA.	PHOS.	MANG.	ALUMINA	LIME.	MAG. MESIA.	SULPH.	ORE A VOL.	MOIST.
Angeline, Hard	63.66	66.89	2.25	.013	.09	1.27	.11	.04	.014	.50	4.81
Angeline Hematite	59.14	65.37	2.69	.041	.39	1.05	.12	.08	.018	2.01	9.31
Angeline, South	54.60	62.17	4.75	.135	.27	1.63	.25	.15	.020	3.68	12.17
Bell	40.25	41.18	37.22	.030	.18	1.04	.09	.12	.031	1.62	2.76
Cambria	55.34	61.80	6.70	.051	.260	1.900	.970	.340	.008	2.120	10.45
Cambridge	51.91	62.04	5.78	.192	1.00	.142	1.66	.88	.002	1.37	16.32
Champion No. 1 *	64.35	63.00	4.58	.055	.09	2.27	.96	.66	.007	.....	1.00
Cleveland Bessemer	66.80	67.09	2.75	.028	.10	1.20	.23	.28	.024	.28	.43
Cliffs Shaft	61.82	62.50	3.40	.107	.37	1.56	1.34	1.12	.027	2.20	1.08
Dartmouth *	65.00	65.75	2.52	.032	.18	1.74	.32	.11	.014	.32	1.14
Emery *	59.40	60.00	10.25	.110	.30	2.20	.53	.20	.020	.....	1.00
Foster	49.58	51.45	18.45	.142	.27	1.10	.18	.32	.020	5.18	3.63
Harvard Bessemer *	56.89	65.00	3.15	.050	.31	1.76	.32	.18	.020	2.09	12.48
Ishpeming	51.06	59.52	6.75	.067	.48	2.18	.22	.40	.010	4.17	14.18
Jackson, Pit 7	52.70	55.21	13.71	.067	.....	3.25	.....	.....	.....	.....	4.55
Jackson Hard, No. 2 Bess *	48.56	50.01	24.23	.047	.15	2.93	.....	.....	.02	.....	2.90
Kenyon *	48.16	52.00	18.00	.110	.71	1.22	.30	.19	.027	3.83	11.34
Lake	51.69	60.00	5.79	.088	.71	2.70	.35	.67	.010	4.43	13.85
Lake Bessemer *	56.12	64.21	3.98	.038	.52	1.51	.23	.15	.023	1.80	12.59
Lake Bessemer East End *	53.74	61.00	7.40	.043	.42	2.17	.28	.16	.023	2.71	11.99
Lake Silica	42.86	48.16	25.17	.039	.43	1.69	.36	.47	.035	1.65	11.00
Lake Superior No. 1 *	64.25	65.00	3.64	.094	.31	2.14	.37	.36	.013	.49	1.16
Lillie	55.43	62.56	5.40	.074	.39	1.97	.34	.11	.006	3.120	11.40
Manganiferous Hematite *	48.67	54.29	7.20	.071	4.61	2.20	.82	2.57	.025	.....	10.35
Marquette	39.26	41.06	36.85	.055	.39	1.07	.20	.16	.020	1.67	4.37
Negaunee	55.76	62.65	4.31	.036	.....	2.83	.....	.....	.....	.....	11.00
Negaunee Non-Bessemer	53.40	60.00	4.31	.115	.....	2.83	.....	.....	.....	.....	11.00
Norfolk *	55.52	56.00	13.43	.055	.11	3.18	.71	1.05	.020	.....	.85
Old Mine Hematite, Bessemer	54.98	63.16	4.17	.067	.49	2.00	.30	.28	.020	2.78	12.95
Old Mine Hem., Non-Bess. *	53.36	61.00	5.50	.101	.75	2.00	.48	.59	.027	2.99	12.52
Princeton *	54.09	64.92	3.16	.055	.73	.159	1.12	.742	.001	1.20	16.68
Queen	53.51	61.40	5.56	.150	.294	2.623	.45	.468	.010	2.90	12.85
Republic Special	66.78	67.07	2.80	.018	Trace	.71	.10	.08	.016	.....	.43
Republic Specular	66.21	66.74	2.70	.034	.18	1.00	.17	.11	.011	.29	.79
Republic Kingston *	63.46	64.00	6.13	.024	.23	.83	.31	.300	.023	.045	.84
Rose	54.40	61.40	6.40	.120	.370	1.800	.420	.110	.008	2.220	11.40
Richmond	43.05	43.60	36.20	.034	.040	.640	.490	.110	.004	2.740	1.27
Salisbury	53.48	62.50	4.44	.117	.31	1.77	.38	.13	.013	4.13	14.43
Salisbury Bessemer	54.12	63.60	3.43	.044	.25	1.38	.13	.18	.017	4.45	14.91
Salisbury Silica	42.99	49.60	28.28	.050	.32	1.75	.18	.30	.021	3.11	13.31
Savoy *	60.08	61.00	9.11	.097	.32	1.97	.45	.39	.020	1.97	1.50
Sec. 16, No. 1 Bessemer	62.23	65.26	4.70	.022	.18	1.59	.29	.22	.015	.50	4.64
Sec. 16, No. 2 Bessemer	60.45	62.06	8.32	.032	.18	1.71	.34	.24	.015	.58	2.59
Section 21, Hematite *	54.53	61.50	6.15	.147	.46	1.29	.48	.20	.027	3.25	11.34
Sheffield	60.05	61.48	9.12	.024	.24	1.82	.13	.08	.024	.55	2.33
Tilden Silica	41.07	41.90	38.30	.033	.10	.82	.19	.13	.018	.65	1.97

MISSABE RANGE.

ORE.	IRON, Natural State.	DRIED AT 212° FAHRENHEIT. IRON.	SILICA.	PHOS.	MANG.	ALUMINA	LIME.	MAG. MESIA.	SULPH.	ORE A VOL.	MOIST.
Adams	57.91	64.03	2.92	.032	.43	1.06	.17	.18	.022	2.25	9.56
Admiral	59.21	63.80	5.10	.027	.329	.590	.220	.142	.004	2.110	7.30
Amelia	58.23	63.46	3.29	.063	.41	2.36	.21	.12	.008	2.05	8.24
Auburn	58.45	64.05	3.05	.045	.35	1.78	.33	.16	Trace	3.16	10.00
Audrey	55.03	62.10	3.45	.060	.89	1.01	.30	.27	Trace	3.32	11.75
Beaver	56.29	63.30	2.20	.068	.52	1.90	.34	.17	.020	3.50	11.20
Biwabik	58.52	63.47	3.75	.030	.59	1.00	.27	.12	.004	2.35	7.60
Canton *	54.72	60.00	4.25	.048	.49	.83	.71	.07	Trace	7.21	10.00
Commodore *	59.14	64.10	3.90	.029	.20	1.21	.24	.06	.004	2.40	9.80
Duluth	54.11	60.94	5.10	.043	.38	1.48	.30	.16	.011	5.46	11.20
Fayal	56.97	62.09	3.58	.031	.91	1.09	.30	.24	Trace	3.66	9.76
Genoa	57.18	63.49	4.05	.030	.43	.84	.40	.35	Trace	3.30	9.94
Hartley	58.21	64.94	2.69	.027	.44	1.55	.45	.17	.004	3.77	10.36
Hibbing	58.25	65.34	2.78	.028	.441	1.066	.08	.109	.011	3.34	10.71
Juniata	51.50	58.88	5.80	.060	.94	.....	.....	.....	.....	.....	12.54
Linwood	57.19	63.44	3.90	.049	.64	1.45	.30	.19	.008	2.60	9.04
Mountain	56.07	62.95	4.01	.040	.35	.....	.....	.....	.....	.....	12.32
Oliver	54.46	61.96	4.76	.060	.54	.....	.....	.....	.....	.....	13.09
Pillsbury	56.87	63.72	3.41	.028	.72	1.09	.09	.13	.001	3.86	9.33
Preble	52.37	58.91	5.34	.079	1.35	.....	.....	.....	.....	.....	10.25
Pinehead	56.90	63.50	4.07	.032	.47	1.21	.19	.10	.011	.....	11.96
Sellers	58.23	64.39	3.49	.036	.39	1.35	.12	.08	.026	2.90	9.66
Sparta	60.77	65.30	2.70	.029	.31	.74	.45	.33	Trace	2.35	8.94
Top Brown	58.14	62.45	3.29	.052	.52	.83	.50	.16	.004	3.94	8.80
Vulcan	60.08	64.60	2.06	.027	.50	.80	.35	.25	Trace	2.90	7.00

VERMILLION RANGE.

ORE.	IRON, Natural State.	DRIED AT 212° FAHRENHEIT. IRON.	SILICA.	PHOS.	MANG.	ALUMINA	LIME.	MAG. MESIA.	SULPH.	ORE A VOL.	MOIST.
Chandler	60.96	64.73	4.02	.037	.11	1.94	.40	.11	Trace	.90	5.78
Long Lake	57.11	61.64	6.97	.042	.17	3.58	.27	.17	Trace	1.34	7.35
Minnesota	60.67	67.87	2.50	.035	.11	.69	.34	.11	.005	.20	1.04
Pilot	55.06	60.10	6.90	.044	.35	2.96	.21	.09	.024	1.34	8.38
Pioneer	59.80	64.48	4.38	.037	.362	2.133	.10	.072	None	1.34	7.26
Red Lake	61.66	66.52	4.58	.122	.14	1.74	.47	.46	.007	.75	2.62
Vermillion	65.91	66.75	2.19	.187	.08	.90	.56	.25	.010	.43	1.21

TUYERES IN THE IRON BLAST FURNACE.*

BY B. F. FACKENTHAL, JR., RIEGELSVILLE, PA.

The earliest history shows that, in the reduction of iron ores, natural draft was used to supply the blast, and that, when artificial blast was first used, it was supplied by leather bellows, usually made of skins, which were worked by the feet or hands, the blast entering the furnace through one tuyere or nozzle. The prehistoric bellows and its tuyere or nozzle are still in use in some form wherever iron is made.

The original Durham furnace, built in 1727, at Durham, Pa., which was one of the earliest blast furnaces in this country, was blown with a bellows, the power being supplied by a water-wheel. The old records show the purchase of leather at various times to repair the bellows, and mention the freezing of the water-wheel as one of the causes for going out of blast.

In the early days of our iron manufacture but one tuyere was used; in fact, a considerable number of charcoal furnaces continued to use but one tuyere down to recent years. I am told that a cold blast charcoal furnace, situated in Berks county, Pa., built in 1792, continued to use but one tuyere as late as 1889, when the furnace was remodeled and equipped with four tuyeres.

My earliest recollection of any blast furnace is that of the two old anthracite furnaces at Durham. These were demolished in 1874 to make way for the one large furnace, which was first put in blast Feb. 21, 1876. At the time I speak of these two old furnaces were blown through three tuyeres, which were made of one-inch wrought iron coils covered with cast iron. The holes in the goose-necks, for pricking the tuyeres, were closed by means of a plug, with a handle about 12 inches long, made of gas pipe. My idea at that time was that these plugs were for the sole purpose of being taken out by Uncle Billy Martin, the founder, to frighten visitors, particularly small boys, who had no special business around the furnace. In later years I learned that Uncle Billy used to determine the temperature of the blast by spitting on the tuyere-pipe. This, however, was not quite as crude as the method of the old charcoal founder, of whom it was said that he could determine the conditions of his furnace by sticking his hand in the tail-race.

During the early blasts of the Durham furnaces, which were built in 1848-50, and were therefore among the earlier anthracite blast furnaces, home-made wrought iron tuyeres were used. They were known as welded tuyeres. One of these old tuyeres is, at the present time, suspended back of the furnace, where it was long used as a gong to call the fillers to the cast house. This tuyere is a hollow truncated

* A contribution to the discussion at the Buffalo meeting of the American Institute of Mining Engineers.

cone, 24 inches long; the sheet iron rims are one-quarter inch thick. The large end has 12-inch outside and seven-inch inside diameter, and the ring welded in this large end is one-half inch thick by two inches wide. The small or nozzle end has nine-inch outside and five-inch inside diameter, and the ring welded in this small end is one-half inch thick by 1½ inches wide. These tuyeres were made of sufficient length to permit them to be cut off when burnt and a new end welded in. A skillful mechanic, according to the standard of those days, was required to make these tuyeres and keep them in repair; and he usually commanded good wages.

The water tuyere was invented and first used by Mr. Condie. It was an invention found necessary when the hot blast, patented by Mr. Neilson, in 1828, was first applied to the blast furnace. At first, tuyeres made of wrought iron coils were used; then tuyeres made of cast iron, which were discarded for welded tuyeres, such as I have described above; but wrought iron coil tuyeres came again into general use, and held their own for many years, until they were gradually replaced by bronze tuyeres. I am told that cast iron tuyeres were formerly in common use in this country. I have never seen one of them; but they are described as being square on the outside, and measuring about 18 inches at the large and 16 inches at the small end. The opening through the tuyere was circular, having about nine inches diameter at the large end and five inches at the nozzle; and there were four square openings, one at each corner, for attaching the water supply and discharge pipes. These holes were closed with wooden plugs, in which a hole was bored and the pipe was secured with wooden wedges. Only two of these connections were used at a time. The cast metal was three-quarters inch thick.

The new Durham furnace, first blown in Feb. 21, 1876, was equipped with a Lurmann closed front, and was one of the first blast furnaces in this country to use this arrangement successfully. The royalty paid for the right to use the patent was $1,900, being $100 per foot of bosh-diameter.

During the first and second blasts of this furnace but five tuyeres were used. The hearth and bosh walls were thick, the hearth was small, and the results obtained were not entirely satisfactory as to either output or fuel economy; and, moreover, the furnace showed a constant tendency to scaffold. The hearth was then enlarged, and the number of tuyeres was increased to seven. These changes produced a marked improvement in every respect; but it cannot be claimed that this was due entirely to the increased number of tuyeres, though they were certainly of great benefit.

During 1876 bronze tuyeres, furnished by Mr. John M. Hartman, were experimented with at Durham, for a long time. These were among the very first bronze tuyeres used in this country. They were shaped very much like the old fashioned welded tuyeres above described, differing, however, in two essential features, viz., the water feed pipes were extended nside of the tuyere, and delivered the cold water well up to the nozzle; and there was a ground ball-joint between the belly-pipe and tuyere. Clay packing was used between tuyere and water cooler. It was found that these bronze tuyeres gave much better service than the ordinary coil-tuyere, but their cost (about $90 each), was too great to justify their adoption. Several years later, the Witherbee short bronze tuyeres were first introduced in practice.

One of the latest improvements in blast furnace construction is the use of a much larger number of tuyeres, some furnaces having as many as 20. The idea of using a larger number of tuyeres, however, is not new, as the experiment was tried by Mr. Saumel Thomas, at the Thomas Iron Co.'s plant, more than 36 years ago.

In Percy's "Metallurgy" (page 380), reference is made to the Thomas Iron Co.'s furnaces, and the drawing in the back part of that book shows No. 4 furnace, equipped with 11 tuyeres. These, however, as the drawing shows, were not spaced uniformly around the hearth. This was a large number of tuyeres to use in those early days. The operation of the furnace was successful, and the results obtained were satisfactory.

It is, however, of the Thomas Iron Co.'s No. 3 furnace, built at the same time as No. 4, that I wish especially to speak. This furnace was first put in blast July 18, 1862, and was equipped with 21 tuyeres, evenly spaced around the furnace. The furnace was constructed with 21 cast iron columns or buck-stays, and a tuyere was placed between each two. It is to be regretted that the drawings of the tuyere and its arrangement have been lost or mislaid. I am, however, informed by Mr. Thomas, who designed the arrangement, and whose recollection is quite clear, that the tuyeres were made of one-inch wrought iron coils, covered with cast iron, of a rectangular shape, with openings at the nozzle of 1½ by nine inches. As the hearth of the furnace was eight feet in diameter, while the tuyeres projected three inches into the furnace, and the cast iron on each side of the tuyeres was at least two inches thick, making the outside measurement 13 inches, it is apparent that the tuyeres formed a continuous circle around the furnace. This continuous belt of blast cut away the brick work, and caused the tuyeres to sag and direct the current of blast towards the bottom of the hearth. This difficulty was overcome by casting, on the tops of the tuyeres, on the butt-end, lugs which rested against a cast iron plate running continuously around the furnace, above the tuyeres. No water coolers were used in connection with these tuyeres. Moreover, it is probable that the quantity of air used was insufficient for so large a tuyere area. These rectangular tuyeres were replaced from time to time with ordinary coil tuyeres, having a circular opening; but the entire number of 21 tuyeres, part rectangular and part round, continued in use until the end of the blast, July 10, 1863, when the furnace was forced to go out of blast for lack of men, because so many had enlisted for the war.

I am also informed by Mr. Samuel Thomas that, in his experiment with so large a number of tuyeres, he realized the importance of having some additional cooling arrangement, which led to the use of bosh-coils. He put in and used five courses of coils made of gas pipe of 1½ inch internal diameter, placing them horizontally around the furnace above every fourth course of brick. This would bring them about 18 inches apart, and carry them about 7½ feet above the center line of the tuyeres. They were built in the brick-work, with about 16 inches of brick on the outside. These bosh-coils were in use several months; but the founders were prejudiced against them and accused them of being the cause of every little trouble or irregularity in the operation of the furnace, and for that reason they were abandoned.

It can be said, however, that Mr. Thomas was the pioneer in using not only a large number of tuyeres, but the bosh-coil as well. A patent has recently been granted for the very arrangement of tuyeres which Mr. Thomas used at Hokendauqua in July, 1862, more than 36 years ago; and bosh-coils have also since been patented. Mr. Thomas does not claim to have used this large number of tuyeres successfully, satisfactory results having been prevented by imperfect cooling-arrangements; but in view of the fact that many of the latest and best-constructed furnaces are now using a large number of tuyeres, his experience adds a very valuable contribution to the literature of this subject.

During 1893–94 No. 1 furnace at Hokendauqua was rebuilt, with 17-foot bosh-diameter and 80-foot height, and eight tuyeres. It was put in blast August 1, 1894. The results were, in the main, not very satisfactory. The old iron-pipe stoves employed during the blast were too small for so large a furnace, and proved a constant hindrance to economical work.

During the fall of 1897 the old iron-pipe stoves were replaced with three fire-brick stoves, each 20 feet by 80 feet; the bosh of the furnace was enlarged to 17 feet 9 inches in diameter, and the tuyeres were increased in number from eight to 12. The second blast was commenced Jan. 8, 1898; and during the first six months, running on a foundry mixture, the fuel-consumption, including the coal used to blow in with, was 1 ton, 1 cwt., 2 qrs., 10 lbs. (1.08 tons) per ton of pig-iron produced. The fuel consumption for some months was less than one ton per ton of iron, with a maximum output of 1,327 tons of pig-iron per week. The total output for the first six months of the blast was 46 per cent greater than for the corresponding time of the first blast. During the second blast, now in progreses, the furnace, with the additional number of tuyeres, works with regularity, has but little tendency to scaffold, and, in this respect, shows a great improvement over the first blast. It is almost impossible to make a comparison of the blast-pressure between the two campaigns, as the area through the ovens during the first blast was not sufficiently large, and

in consequence the back-pressure was very great. I am inclined to think, however, that the blast-pressure under the same conditions would not be less with 12 than with eight tuyeres; but in so large a furnace I am convinced that more uniform results can be obtained with the increased number of tuyeres.

INDUSTRIAL SUMMARY.

New Buyers in the Market, and Some of Their Wants:—

[If you are in need of machinery of any description, please notify *The Iron Trade Review*, and we will put you in communication with our advertisers at once.]

The Dearborn Brass Manufacturing Co., at Chicago, has been incorporated; capital stock $5,000; manufacturing. Incorporators, Charles S. Johnson, William S. Oppenheim, Walter S. Holden.

The Palmer Steel & Iron Co., Chicago, has been incorporated, capital stock, $100,000. Incorporators, John H. Palmer, John D. Briggs and Walter I. Moody.

The Stanton Heater Co. has been incorporated, at Bellaire, O., with a capital stock of $50,000. The company will manufacture a general line of heating and ventilating appliances. The incorporators are Howard Kirk, Henry Stanton, E. H. Rider, C. W. Dickens, and W. C. Warnock.

A new industry is being organized in Winsted, Conn., to manufacture machinery, more especially milling machinery. S. A. Herman and W. S. Hurlbert, of Winsted, and L. C. Carter, of the Pratt & Whitney Co. of Hartford, are interested in the enterprise. Capital stock $12,000.

The Baltimore Bolt & Iron Works, Baltimore, Md., have been organized by William D. Jameson, Charles S. Rich, Dall Worthington, Engelbert C. Lawrence, Harry D. Harvey and Maurice E. Skinner.

Munson Brothers Co. of Utica, N. Y., has been incorporated to manufacture machinery; capital, $100,000. Directors are: Alfred H. Munson, Edmund L. Munson and Florence A. Munson, Utica.

New Construction:—

E. T. Harris Co., 545 W. 15th street, Chicago, is building a foundry.

F. A. Godcharles Co., Milton, Pa., are erecting a new mill in connection with their rolling mill and nail plant.

The Wire Mattress Co., Kenosha, Wis., has plans under way for a 3-story addition 80x126 feet, to cost $15,000.

At Peru, Ill., plans are in preparation for a machine shop for the Western Clock Mfg. Co., to cost $8,000.

The new steel building under way at the Black-Pollak Iron Co.'s plant at Steelton, near Carthage, O., is 200x100 feet. It will permit of turning out shafting up to 18 inches in diameter.

At Baltimore, the new plant of Structural Iron Co. will have a main building 200x136 feet. Electricity will be used in driving the machinery.

The contract for the erection of the car shops for the P. & R. Co. at Schuylkill Haven, Pa., has been awarded to Armstrong E. Princetenhoff.

The Reading Screw Co. will remove its plant from Philadelphia to Norristown, Pa., where it will erect a plant 50x163 feet.

At Milwaukee, F. Kempsmith has begun work on a machine shop addition, to cost $4,000.

It is reported that the United States Radiator Co. will build a new radiator works at Dunkirk, N. Y.

Naval engineering officials have planned the construction of a new machine shop at Brooklyn navy yard entirely different from that of the plant recently burned. The present idea is to extend the present boiler shop toward the drydocks, a distance of 400 feet, move the boiler-making plant to the lower end of the structure, and devote the western end to the machine shop, pending the erection of a new building on the site of the old one. This new building will be modeled on the plan of the construction machine shop, one-story high, with a monitor roof, 365 feet long, and about 150 feet wide, the added depth of seventy-five feet being taken from the length of the boiler shop.

Fires and Accidents:—

Fire destroyed the mechanical hall of the West Virginia university, Morgantown, W. Va., with valuable papers and equipment. The loss is $40,000; insurance, $28,000.

Fire destroyed the core department of the D. M. Osborne & Co.'s shops at Syracuse, N. Y., Feb. 22. Caused $5,000 loss.

The Springfield (O.) Boiler Works were partly destroyed by fire Feb. 26. Insurance, $15,000; loss about the same. Machinery was destroyed.

Wolverine Brass Works, Grand Rapids, Mich., lost several thousand dollars by fire last week; insured.

Power Equipment and Machine Tools.

The Edward P. Allis Co., Milwaukee, Wis., has been compelled recently to decline a number of orders because the desired deliveries could not be made. Among important February contracts are five vertical cross compound blowing engines for Laughlin & Co., of Pittsburg. These engines are similar to the ones furnished to the Oliver & Snyder Steel Co., Ætna-Standard Iron & Steel Co. and Carnegie Steel Co. Each of the machines weighs approximately 350 tons. The South Side Elevated Railway Co. of Chicago have placed an order for two more cross compound engines for their station. The new engines drive 1,600 kilowat generators. The McCormick Harvesting Machine Co., of Chicago, have placed an order for four large compound engines of about 1,500 h. p. each. A large direct coupled engine has been ordered by the Altoona & Logan Valley St. Railway Co., of Altoona, Pa. The company also received an order for another engine to go to the tramways of Buenos Ayres, Argentine Republic. This machine is a duplicate of the three compound engines shipped to Buenos Ayres a year ago.

The contract for equipment of the wire drawing and galvanizing plant of the Page Woven Wire Fence Co., at Monessen, Pa., has been placed with the Morgan Construction Co., of Worcester, Mass.

A new 500 h. p. boiler is being added to the equipment of the Ohio Iron & Steel Co.'s blast furnaces at Lowellville, O.

The Carnegie Steel Co., Ltd., has just awarded the contract for six large blowing engines to the Southwark Foundry & Machine Co., of Philadelphia, through its Pittsburg representative, H. R. Cornelius. The group will cost about $250,000, and will be located at the Edgar Thomson and Carrie blast furnaces, one being placed at the latter group. The engines are compound quarter crank steeple blowing engines. Each engine will have a 44-inch diameter high pressure, and 78-inch diameter low pressure cylinder, and 78-inch diameter air cylinder, with 60-inch stroke. The engines will have a central condensing plant for the entire group at the Edgar Thomson works. Each engine will have a capacity of 40,000 cubic feet of free air every minute.

The Strachan Machine Shops at Sault Ste. Marie, Mich., were taken charge of last week, under lease, by M. Michael Schmaltz and Peter J. Brady, of Bay City. They will operate the shops under the name of the Marine Iron Co., and will manufacture marine and stationary engines, boilers, and all kinds of machinery.

The Essen Coal Co., Pittsburg district, has purchased from the Link Belt Machinery Co. a 12-ton electric locomotive, which will be installed in the Essen No. 3 mine on the Panhandle railroad. It will be the largest and heaviest locomotive of the kind operated in the Pittsburg district mines.

Foundations are being laid for a new engine soon to be installed at the Williams mill of the Brown-Bonnell Iron Co., Youngstown, O.

The Cleveland Ship Building Co. is building a Cuyahoga blowing engine for the blast furnaces of the Cleveland Rolling Mill Co.

The Buss Machine Works, Holland, Mich., have taken a large order from Amsterdam, Holland, for car works machinery.

The Pittsburg District:—

The Schoenberger Steel Co. has let a contract to the E. P. Allis Co., of Milwaukee, for a pair of vertical cross compound condensing engines and a horizontal tandem compound condensing engine. These engines will drive the new rod mill.

The large demand for iron has started up all the puddling

We Have Heard it Said

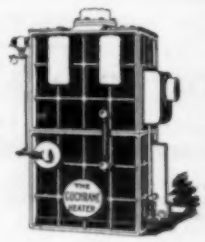
(By those who do not know) that our COCHRANE HEATERS and COCHRANE SEPARATORS are high priced. NOT SO—anything but high priced. May be you got the idea because we keep telling you how good they are—what good things we put in them. Like well built mince pies, they have a first-class casing and "INSIDES," which make them worth trying.

We don't make the cheapest heater on the market—can do it, but won't. Somebody has to decide what should go in a heater. Having 13 or 14 years of experience right in this line—we've decided—and there's no skimping.

No other heater can give hotter water and better purification—is more durable or easier to clean.

Did you ever clean a heater? Not an easy matter unless it's a "COCHRANE."

Shall be pleased to hear from you.



Harrison Safety Boiler Works, Col. Sta., Philadelphia, Pa.

plant of the Republic Iron Works, of Pittsburg, and 50 furnaces are now being operated six heats to the turn.

It is stated that last year the Bessemer department of the Duquesne Steel Works of the Carnegie Steel Co., at Duquesne, Pa., made 516,794 tons of steel from direct iron in two vessels of 9¼ tons capacity.

The mill of J. Painter's Sons is working on a large order for skelp iron to be shipped to Glasgow, Scotland, where it will be used in a tube manufactory.

The erection of the three plate mills recently purchased by the Carnegie Co. from the Bethlehem Iron Steel Co., was begun at Homestead this week. The foundations have been finished and the mills will be in operation by July 1. The new universal plate mill and the new open-hearth mill at the Munhall end of the plant are almost finished, and are expected to make steel by the latter part of May.

H. G. Morse, ex-president of the Edgemoor Iron Works, has been in the city on business connected with the establishment of a ship building yard at Baltimore. The Pittsburg works are asked to figure on steel construction and a portion of the equipment. John K. Cowan, President Harlan, of Wilmington, Del., and others are interested in the project.

Articles of incorporation of the Park Steel Co. were filed with the Secretary of State of New Jersey March 6, with a capital stock of $10,000,000, full paid in. The company is authorized to acquire the property of Park Bro. & Co., Ltd., of Pittsburg, and to manufacture any form of iron and steel. The incorporators are George D. Halloch, Plainfield, N. J.; Park E. Bell, Charles C. Ramsey, Herbert L. Grigg and Charles W. Pierson, of New York. Their names were used merely for incorporation purposes. This means the going out of existence of the limited partnership association operating the Black Diamond Steel Works in Pittsburg, and replacing it with a corporation. The official organization of the limited partnership will not be changed. William G. Park will remain president; D. E. Park as vice-president, and D. C. Clapp as secretary and treasurer. The other members of the firm are James W. Park, Charles E. Clapp, John A. Sutton, George Wright, and Gilbert M. Black. It is thought that the formation of the new company means improvements and extensions to the plant of the steel company, the organization of the company as a corporation giving it greater facility of operation.

General Industrial Notes:—

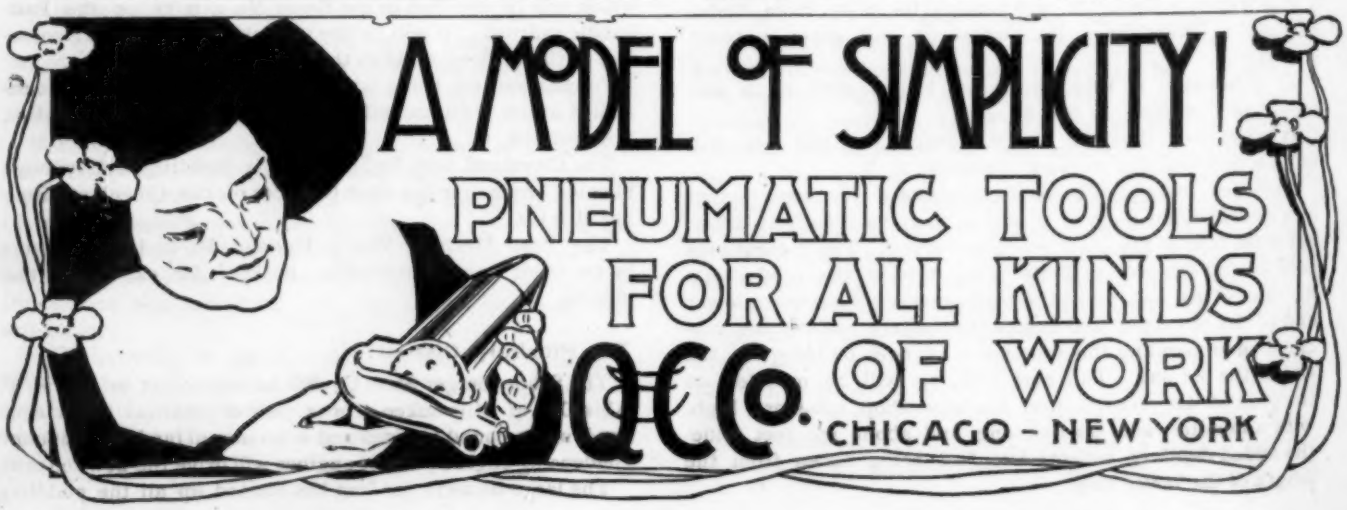
At Youngstown, O., the Mahoning Iron Co.'s 9-inch mill suspended operations a portion of last week on account of inability to procure billets.

The Tennessee Coal, Iron & Railroad Co. has bought out the Smith Mining Co. and will operate the latter's ore mine properties at Hillman, Fossil, Alice, Muscada and Ishkooda, in the Birmingham, Ala., district. The land on which the mines are located already belonged to the Tennessee Coal, Iron & Railroad Co. The Smiths were working the ore mines on a contract to supply the Tennessee company with so much ore at so much per month for a term of years. The contract had yet two years to run.

The Wm. B. Pollock Co., recently incorporated with capital stock of $100,000 to succeed the firm of William B. Pollock & Co., held its annual meeting last week, resulting in the selection of the following board of directors: William B. Pollock, Porter Pollock, W. B. Jones, C. W. McClure, and W. W. McKelvey. The board elected the following officers: President, William B. Pollock; vice-president and manager, Porter Pollock; secretary and treasurer, W. B. Jones.

G. H. Clowes, of Randolph & Clowes, manufacturers of copper and brass tubes, at Waterbury, Conn., and employing 800 persons, has been in Youngstown recently with a view to moving the plant to that city. It is said that a large saving in freight could be made by locating at a Western point.

The American Steel & Wire Co. will declare its quarterly dividend of 1¼ per cent on its preferred stock some time next month. The company should earn this year, it is estimated, about $9,000,000. The preferred stock is $40,000,000. This draws 7 per cent cumulative dividend, and would be entitled to $2,800,039 of the earnings. As the management of the company is to be conservative, no dividend will be declared at



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Proprietors of the CELEBRATED Mount Savage Fire Brick

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Established 1841. Capacity, 60,000 Per Day; 18,000,000 Per Year.

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OAK HILL FIRE BRICK AND COAL CO.,
OAK HILL, OHIO.

the next meeting of the board of directors, on $50,000,000 of common stock, but it is believed that a dividend will be declared on the common stock for the third quarter and possibly for the second quarter.

It is estimated that the Federal Steel Co. will earn $4,000,000 this year and will do much better in the following year.

The National Wire Co. has purchased the business plant and good will of the New Haven Wire Co., of New Haven, Conn. The amount paid was $75,000, and $35,000 of this was presumably paid in cash, a mortgage of $40,000 being taken for the balance.

The new charcoal plant under construction by the Ashland Iron & Steel Co., Ashland, Wis., is under patents of Dr. L. Zwillinger, of Vienna. It is expected a considerable saving over present methods of charcoal manufacture will be secured. Wood is converted into charcoal in 48 hours, the charcoal containing 88 per cent carbon and the gases and acids being saved.

The Wellman Steel Works at Thurlow, Pa., have been sold to a syndicate of capitalists represented by Frank Samuel, of Philadelphia. S. A. Crozier, of Upland, has been the principal stockholder. The purchasers will start up the plant.

The sale of the Jefferson Iron Works plants at Steubenville, O., to stockholders of the La Belle Iron Works has been confirmed, and the lease of the blast furnace to the Aetna Standard Iron & Steel Co. has been terminated. The total indebtedness is $111,000, so that the proceeds of the sale leave very little for the stockholders. The purchasers have also secured a tract of land north of the mill. The latter will be started up soon.

Negotiations have been in progress for some time for the lease of the Baltimore & Ohio Rolling Mill at Cumberland, Md., by the Messrs. Wood, of Sharon, Pa.

The Brier Hill Iron & Coal Co., Youngstown, O., has made a shipment of 47 cars of pig iron to Genoa, Italy.

The Watson Foundry Co., Cleveland, made an assignment March 6. The assets are placed at $4,000 and liabilities at $6,000.

Excavation for the foundation walls for a large addition to No. 2 blooming mill of the Pennsylvania Steel Works at

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MANUFACTURERS OF

Tin Plate Bars, Steel Billets, Blooms and Bessemer Pig Iron.

Steelton, Pa., is being made. Several new soaking pits and heating furnaces will be put in. The mill will also be supplied with a large electric crane, for drawing and charging.

At Tamaqua, Pa., the Vulcan Iron Works, which are controlled by Wilkesbarre capitalists and have been idle more than a year, will shortly resume operations.

It is reported that the option of the Brown-Bonnell Iron Co., of Youngstown, O., on the Sharpsville Furnace at Sharpsville Pa., was allowed to lapse.

The Eagle Iron Co. has just been organized in Chattanooga, Tenn., and will hereafter operate the furnace at Attalla, Ala. The following officers have been elected: President, L. S. Colyar; vice-president, J. H. Barr; secretary, Graham Crabtree. The new company has acquired control of the plant and a force of men is at work putting it in shape to go into blast by April 1.

For the water pipe contract of the city of Cleveland, there were but two bidders last week—the Addyston Pipe & Steel Co., of Cincinnati, and the Lake Shore Foundry Co., Cleveland. The Addyston Co. bid $22.10 per ton and the Lake Shore Foundry $18.90 per ton. The freight charge from Cincinnati is about $1.50 per ton. Last year the Addyston Co. furnished the pipe used by Cleveland at $14.93 a ton. The contract has not yet been awarded.

It is not expected that the Britton Tin Plate Mill, Cleveland, will resume operations. The real estate was not sold to the American Tin Plate Co., but only equipment, stock etc., and these were to be removed within a stated time.

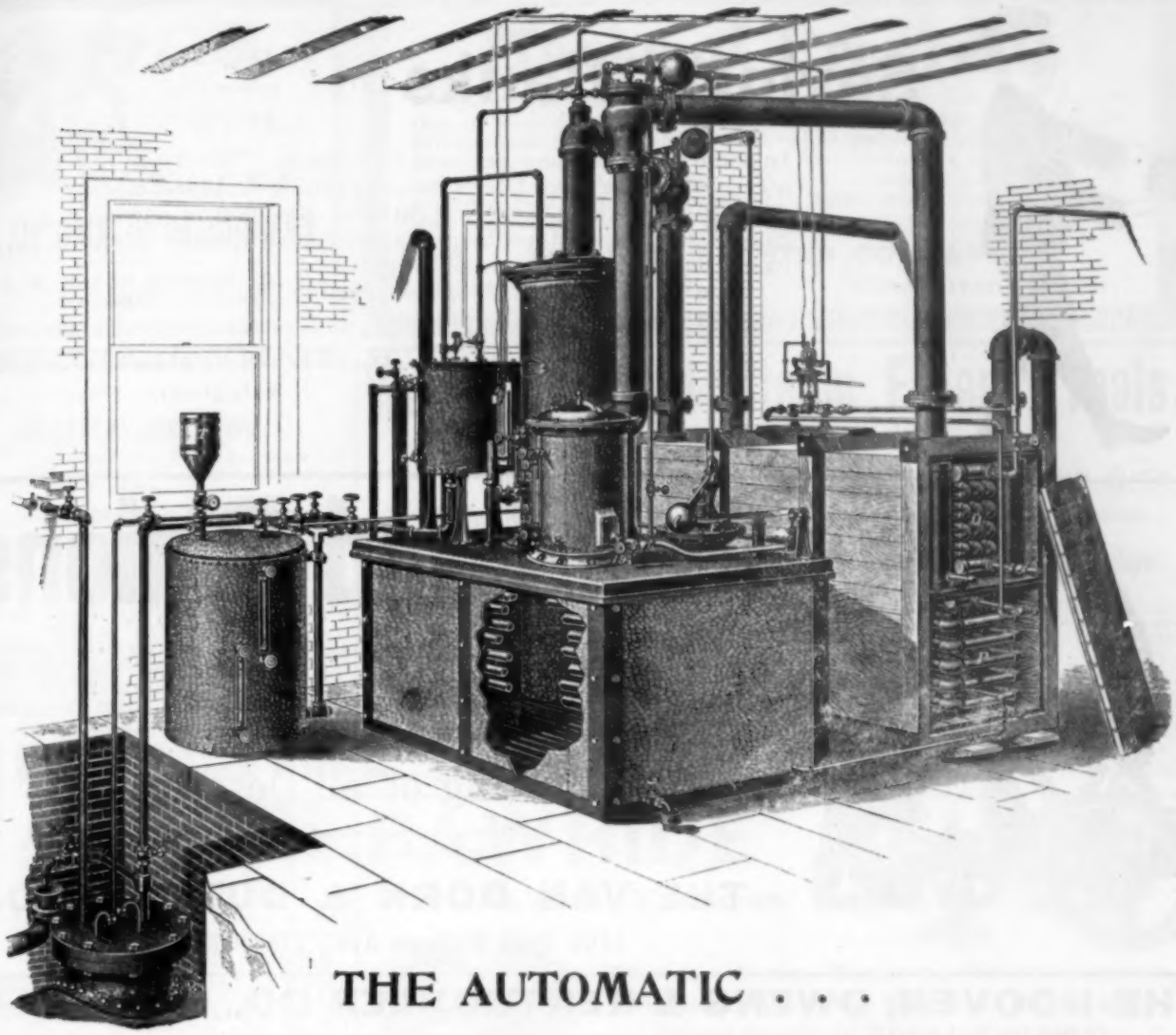
The list of officers of the new brass consolidation organized at Waterbury, Conn., with a capital of $20,000,000, indicates that it includes already the Coe Brass Co., of Torrington; the Scoville Manufacturing Co.; Benedict & Burnham, Holmes, Booth & Haydens, Waterbury Brass Co., and the Matthew & Willard Co., all of Waterbury. Besides these newspaper reports include several brass and copper companies of the lower Naugatuck valley.

The report has been given currency in the past two weeks that the John A. Roebling's Sons Co. had been purchased by the American Steel & Wire Co. As stated at the time the enlarged American Steel & Wire Co. was formed, negotiations were carried on for the acquisition of the Roebling plants, but nothing was concluded. Nothing definite has been done since that time.

Bids have been asked at Philadelphia for the erection of buildings for the exposition of manufactured goods of the United States suitable for export, to be held in that city next September, October and November, under the auspices of the Philadelphia Commercial Museum and the Franklin Institute.

William A. Perrine, secretary of the Iron Molders' Conference Board, reports that the 1,500 members of the Iron Molders' Union in New York are now employed, and that wages range from $2.50 to $3. In 1893 wages for these same employes ranged from $1.33 per day to $1.93.

Cincinnati papers report negotiations to include the Laidlaw-Dunn-Gordon plant in a proposed consolidation of manufacturers of pumping machinery. Nothing tangible has developed in this project as yet.



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The Pope Manufacturing Co., Hartford, Conn.
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The Crescent Watch Case Company, Newark, N. J.
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McGill University, Montreal.
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The National Sewing Machine Co., Belvidere, Ill.
The Elgin National Watch Co., Elgin, Ill.
The Sterling Cycle Works, Kenosha, Wis.
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The O'Hara Waltham Dial Co., Waltham, Mass.
The American Bank Note Company, New York.
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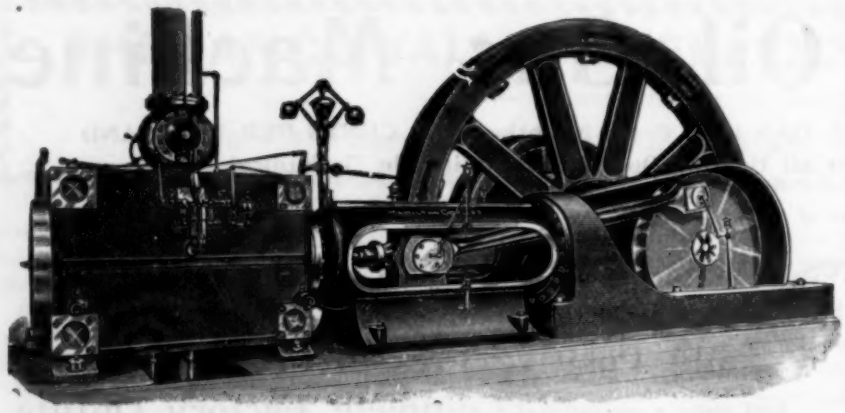

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All Right
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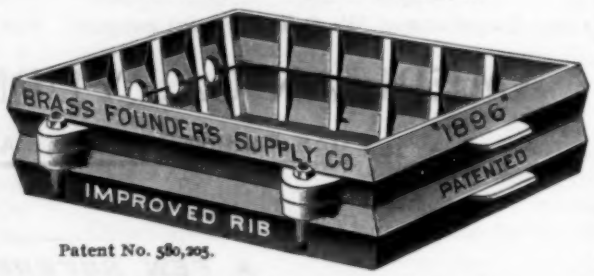

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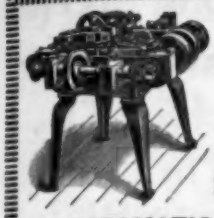

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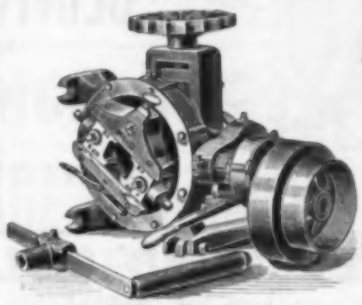

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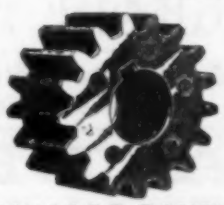

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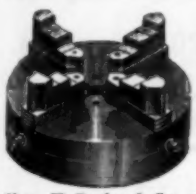

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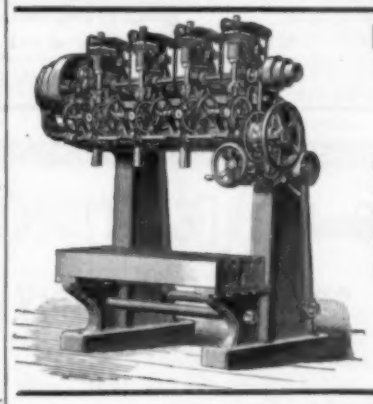

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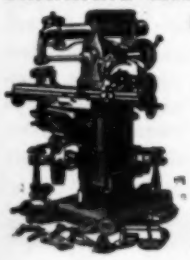

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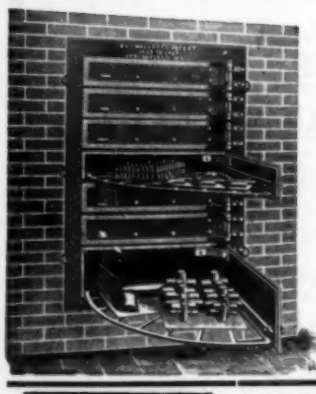

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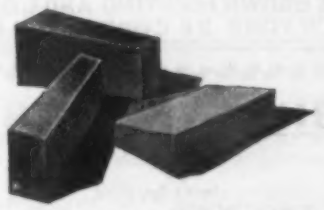

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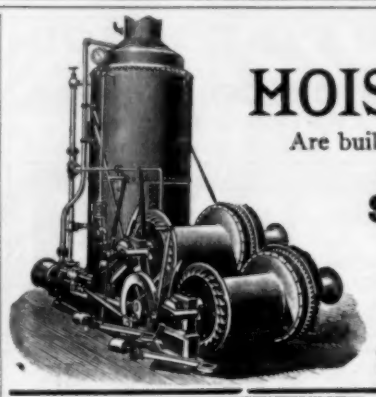

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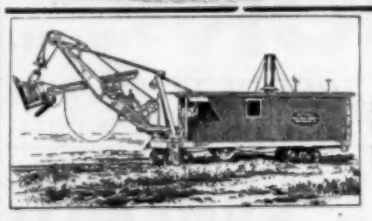

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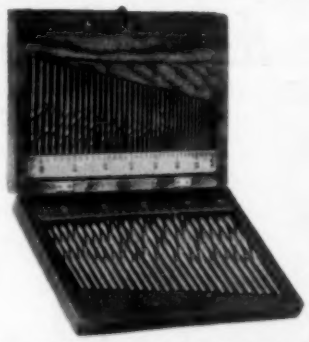

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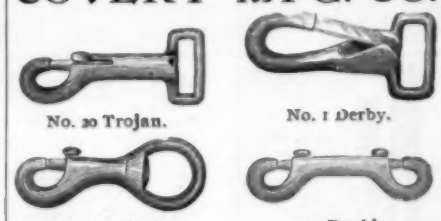

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EXTRACT FROM PREFACE:

In the preparation of the second edition of our Handbook, the general plan of the first edition has been followed, viz., to present in concise form such data and information as are useful to the chemist and metallurgist. Several tables of the first edition, which were of somewhat limited use, have been omitted, while more than one hundred pages of new matter have been added.

The methods for analysis of iron ore, iron and steel and for assaying have been given briefly, but perhaps as much in detail as is consistent with the general scope of the book. Several changes and additions to the Specific Gravity tables have been made by adoption of later and more accurate values.

In the notes on blast furnace practice have been outlined the more important theoretical and practical points, which, it is hoped, will be of some service to those interested in the manufacture of iron.

The hygrometric table gives the necessary information for determining the amount of moisture in air, a subject whose importance in metallurgical operations is being more fully recognized at present than heretofore. This table is new and is based on the most accurate data available at the present time.

The tables of weights and measures, United States and foreign, have been very much amplified, and the conversion tables for United States and metric weight and measures of the U. S. Coast and Geodetic Survey included, the latter being based on the legal standard for this country.

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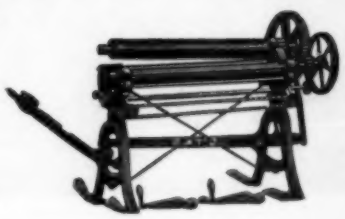

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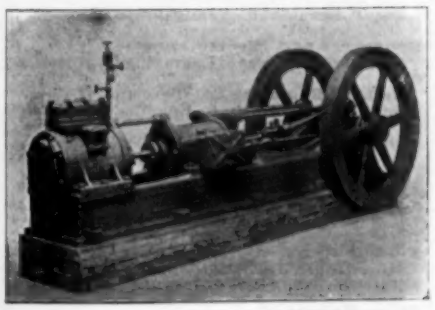

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Cleveland Tool & Supply Co., Cleveland, O.

Engineers and Contractors—
Heyl & Patterson, Pittsburg, Pa.
Meehan Boiler & Construction Co., Lowellville Ohio.
E. E. Erickson, Pittsburg, Pa.
Benedict Crowell, Cleveland, O.
John T. Jones & Co., Chicago, Ill.
Riter-Conley Mfg. Co., Pittsburg, Pa.
Jeffrey Mfg. Co., Columbus, O.

Engine Packing—
Jenkins Bros., New York City.
C. H. Besly & Co., Chicago, Ill.

Engineers' Supplies—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.

Engine Lathes—
U. Baird Machinery Co., Pittsburg, Pa.
Edwin Harrington & Son Co., Philadelphia

Engines (Oil)—
The Aultman Co., Canton, O.

Engines (Steam)—
Wm. Tod & Co., Youngstown, O.
B. F. Sturtevant Co., Boston, Mass.
The Edward P. Allis Co., Milwaukee, Wis.
The Hooven, Owens & Rentschler Co., Hamilton, O.
Lane & Bodley Co., Cincinnati, O.
The Aultman Co., Canton, O.
Geo. B. Sennett Co., Youngstown, Ohio.

Engravers and Electrotypers—
Central Electrotype & Engraving Co., Cleveland, O.
National Engraving Co., Cleveland, O.
Eclipse Electrotype & Eng. Co., Cleveland, O.

Exhaust Heating Apparatus—
B. F. Sturtevant Co., Boston, Mass.

Fans—
American Gas Furnace Co., New York City.
B. F. Sturtevant Co., Boston, Mass.

Feed Water Heaters and Purifiers—
Stilwell-Bierce & Smith-Valle Co., Dayton, O.
Harrison Safety Boiler Works, Philadelphia, Pa.

Files, Makers of—
C. H. Besly & Co., Chicago, Ill.

Fire Brick and Clay—
J. V. Rose, Sharon, Pa.
Union Mining Co., Mt. Savage, Md.
Clearfield Fire Brick Co., Clearfield,
Dover Fire Brick Co., Cleveland, Pa.
Diamond Fire Brick Works, Akron, O.
F. B. Stevens, Detroit, Mich.
The S. Obermayer Co., Cincinnati, O.
Chicago Fire Clay Product Co., Chicago, Ill.
Columbia Fire Clay Co., Cleveland, O.
Scioto Star Fire Brick Works, Portsmouth, O.
Kentucky Fire Brick Works, Portsmouth O.
Webster Fire Brick Co., South Webster, O.
Ætna Fire Brick Co., Oak Hill, O.
Oak Hill Fire Brick & Coal Co., Oak Hill, O.
Holmes, Strachan & Co., Detroit, Mich.

Fire Proof Covering—
C. H. Besly & Co., Chicago, Ill.

Flexible Shafts—
Union Boiler Tube Cleaner Co., Pittsburg, Pa.

Foot and Power Lathes—
U. Baird Machinery Co., Pittsburg, Pa.
Edwin Harrington Son & Co., Philadelphia, Pa.

Foundries—
Wm. Tod & Co., Youngstown, O.
Seaman, Sleeth Co., Pittsburg, Pa.
The Lane & Bodley Co., Cincinnati, O.
Hooven, Owens & Rentschler Co., Hamilton, O.
W. A. Jones Foundry Co., Chicago.
Jeffrey Mfg. Co., Columbus, O.
Brass Founders' Supply Co., Newark, N. J.
The Aultman Co., Canton, O.
Riverside Foundry Co., Cleveland, O.

Foundry Equipments—
The S. Obermayer Co., Cincinnati, O.

Foundry Supplies—
Clearfield Fire Brick Co., Clearfield, Pa.
The Ohio Sand Co., Conneaut, O.
Union Mining Co., Mt. Savage, Md.
Dover Fire-Brick Co., Cleveland, O.
Tabor Mfg. Co., Elizabeth, N. J.
F. B. Stevens, Detroit, Mich.
Heber Wells, New York City.
Millett Core Oven Co., Brightwood, Mass.
Hanson McDowell, Chicago, Ill.
Cleveland Facing Mill Co., Cleveland, O.
The S. Obermayer Co., Cincinnati, O.
Garden City Sand Co., Chicago, Ill.
Chicago Fire Clay Product Co., Chicago, Ill.
Brass Founders' Supply Co., Newark, N. J.
Columbia Fire Clay Co., Cleveland, O.
Vulcan Mfg. Co., Pittsburg, Pa.
Scioto Star Fire Brick Works, Portsmouth, O.
Kentucky Fire Brick Works, Portsmouth, O.
Webster Fire Brick Co., South Webster, O.
Ætna Fire Brick Co., Oak Hill, O.
J. V. Rose, Sharon, Pa.
Diamond Fire Brick Works, Akron, O.
Oak Hill Fire Brick & Coal Co., Oak Hill, O.
Holmes, Strachan & Co., Chicago, Ill.
Newport Sand Bank Co., Newport, Ky.

Foundry Facings—
The S. Obermayer Co., Cincinnati, O.
Cleveland Facing Mill Co., Cleveland, O.

Forgings—
Cleveland City Forge & Iron Co., Cleveland, O.
Bethlehem Iron Co., South Bethlehem, Pa.
Braeburn Steel Co., Braeburn, Pa.
Wyman & Gordon, Worchester, Mass.

Friction Metal—
C. H. Besly & Co., Chicago, Ill.
North American Metaline Co., Long Island City, New York.
Swarts Metal Refining Co., Chicago, Ill.

Furnaces—
Brightman Furnace Co., Cleveland, O.
Playford Stoker Co., Cleveland, O.

Furnace Linings—
Union Mining Co., Mt. Savage, Md.

Fuel Oil Burners—
W. S. Rockwell & Co., New York City.
American Gas Furnace Co., New York City.

Galvanized Iron—
Apollo Iron & Steel Co., Pittsburg, Pa.

Galvanizers—
Ætna-Standard Iron & Steel Co., Bridgeport, O.
Apollo Iron & Steel Co., Pittsburg, Pa.

Galvanizing Pots—
Wm. B. Pollock & Co., Youngstown, O.

Gas Burners—
American Gas Furnace Co., New York City.

Gas Furnaces—
American Gas Furnace Co., New York City.

Gear Cutting—
The R. D. Nuttall Co., Allegheny, Pa.
Brainard Milling Machine Co., Hyde Park, Mass.
The Van Dorn & Dutton Co., Cleveland, O.

Gear Cutters—
Brainard Milling Machine Co., Hyde Park, Mass.

Grindstones—
C. H. Besly & Co., Chicago, Ill.

Graphite Paint—
Jos. Dixon Crucible Co., Jersey City N. J.,

Grate Bars—
Geo. B. Sennett Co., Youngstown, Ohio.

Gray Iron Castings—
W. A. Jones Foundry Co., Chicago, Ill.
The Lane & Bodley Co., Cincinnati, O
Brass Founders' Supply Co., Newark, N. J.

Hack Saws—
Millers Falls Co., New York City.
Q & C Co., Chicago, Ill.

Hangers—
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.

Harness Snaps—
Covert Mfg. Co., West Troy, N. Y.

Hoists—
Edwin Harrington Son & Co., Philadelphia.
Reading Crane & Hoist Works, Reading, Pa.
The Lane & Bodley Co., Cincinnati, C.
The Aultman Co., Canton, O.
Lidgerwood Mfg. Co., New York City.

Heaters and Purifiers—
Harrison Safety Boiler Works, Philadelphia.
Stilwell-Bierce & Smith-Vaile Co., Dayton O.

Heating and Ventilating Apparatus
B. F. Sturtevant Co., Boston.

Heavy Hardware—
C. H. Besly & Co., Chicago, Ill.
Parkhurst & Wilkinson Co., Chicago, Ill.

Hoisting Engines—
The Edward P. Allis Co., Milwaukee, Wis.
Earle C. Bacon, New York City.
The Lane & Bodley Co., Cincinnati, O.
Lidgerwood Mfg. Co., New York City.
The Aultman Co., Canton, O.

Hoisting Machinery—
Link-Belt Machinery Co., Chicago, Ill.
Reading Crane & Hoist Works, Reading, Pa.
Jeffrey Mfg. Co., Columbus, O.
The Lane & Bodley Co., Cincinnati, O.
Earl C. Bacon, New York City.
Lidgerwood Mfg. Co., New York City.
Heyl & Patterson, Pittsburg, Pa.
The Aultman Co., Canton, O.
The Brown Hoisting and Conveying Machine Co., Cleveland, O.

Horse Shoes—
Phoenix Horse Shoe Co., Joliett, Ill.

Hotels—
United States Hotel Co., Cleveland, O.

Hydraulic Machinery—
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.

Injectors—
C. H. Besly & Co., Chicago, Ill.

Insurance Companies—
Hartford Steam Boiler I. & I. Co., Hartford, Ct.

Iron Buildings—
Shiffler Bridge Co., Pittsburg, Pa.
Riter-Conely Co., Pittsburg, Pa.

Iron Nails and Steel—
Bethlehem Iron Co., South Bethlehem, Pa.
C. H. Besly & Co., Chicago, Ill.
E. H. Stroud & Co., Chicago, Ill.
Parkhurst & Wilkinson Co., Chicago, Ill.

Iron and Steel Roofing—
Berger Mfg. Co., Canton, O.
Ætna-Standard Iron & Steel Co., Bridgeport, O.

Iron Ore—
Lake Superior Consolidated Iron Mines New York City, N. Y.
Oglebay, Norton & Co., Cleveland, O.
M. A. Hanna & Co., Cleveland, O.

Iron Working Tools—
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C. H. Besly & Co., Chicago, Ill.
The F. B. Shuster Co., New Haven, Conn.
U. Baird Machinery Co., Pittsburg, Pa.
Edwin Harrington Son & Co., Philadelphia, Pa.
Fox Machine Co., Grand Rapids, Mich.
Armstrong Bros. Tool Co., Chicago, Ill.
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Chicago Die and Machine Works, Chicago, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
Skinner Chuck Co., New Britain, Conn.
Cleveland Tool & Supply Co., Cleveland, O.
Brainard Milling Machine Co., Hyde Park, Mass.
Baush & Harris Machine Tool Co., Springfield, Mass.
Massey Vise Co., Chicago, Ill.

Link Belting—
The Jeffrey Mfg. Co., Columbus, O.
Link-Belt Machinery Co., Chicago, Ill.
Heyl & Patterson, Pittsburg, Pa.
The Aultman Co., Canton, O.

Ladles—
The S. Obermayer Co., Cincinnati, O.

Lathes—
U. Baird Machinery Co., Pittsburg, Pa.
Edwin Harrington, Son & Co., Philadelphia.
Bickford Drill & Tool Co., Cincinnati, O.

Machinery Name Plates—
August Becker, Boston, Mass.

Machinists' Tools and Supplies—
H. Bickford, Lakeport, N. H.
C. H. Besly & Co., Chicago, Ill.
U. Baird Machinery Co., Pittsburg, Pa.
Bertsch & Co., Cambridge City, Ind.
Edwin Harrington Son & Co., Philadelphia, Pa.
Fox Machine Co., Grand Rapids, Mich.
Armstrong Bros. Tool Co., Chicago, Ill.
Bickford Drill & Tool Co., Cincinnati, O.
Parkhurst & Wilkinson Co., Chicago, Ill.
Skinner Chuck Co., New Britain, Conn.
Cleveland Tool & Supply Co., Cleveland, O.
Baush & Harris Machine Tool Co., Springfield, Mass.
Massey Vise Co., Chicago, Ill.

Machinists' Vises—
Massey Vise Co., Chicago, Ill.

Machine Screws—
C. H. Besly & Co., Chicago, Ill

Machine Shops—
The R. D. Nuttall Co., Allegheny, Pa.
The Lane & Bodley Co., Cincinnati, O.

Machinery and Tool Steel—
C. H. Besley & Co., Chicago, Ill.
Braeburn Steel Co., Braeburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa
Sanderson Bros. Steel Co., Cleveland, O.
Byron H. White, Chicago, Ill.
Morris & Bailey Steel Co., Pittsburg, Pa.

Magnesia Covering—
C. H. Besly & Co., Chicago, Ill.

Manufacturing Chemists—
James Irwin & Co., Pittsburg, Pa.

Manufactured Iron & Steel—
Bourne-Fuller & Co., Cleveland, O.
Cleveland Rolling Mill Co., Cleveland, O.
Ætna-Standard Iron & Steel Co., Bridgeport, O.
The Morris & Bailey Steel Co., Pittsburg, Pa.
Parkhurst & Wilkinson Co., Chicago, Ill.
Ohio Steel Co., Youngstown, O.

Metal Bearings—
North American Metaline Co., Long Island City, N. Y.
C. H. Besly & Co., Chicago, Ill.

Milling Machines—
U. Baird Machinery Co., Pittsburg, Pa.
Fox Machine Co., Grand Rapids, Mich.
Brainard Milling Machine Co., Hyde Park, Mass.

Mining Machinery—
C. H. Besly & Co., Chicago, Ill.
The Edward P. Allis Co., Milwaukee, Wis.
Earle C. Bacon, New York City.
The Lane & Bodley Co., Cincinnati, O.
Jeffrey Mfg. Co., Columbus, O.
Lidgerwood Mfg. Co., New York City.
Wm. Cramp & Sons, Philadelphia, Pa.
The Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.

Molding Machines—
Tabor Mfg. Co., Elizabeth, N. J.

Mine Pumps—
Fred M. Prescott Steam Pump Co., Milwaukee, Wis.

Molding Sand—
Ohio Sand Co., Conneaut, O.
F. B. Stevens, Detroit, Mich.
S. Obermayer Co., Cincinnati, O.
Garden City Sand Co., Chicago, Ill.
Newport Sand Bank Co., Newport, Ky.

Molders' Tools—
The S. Obermayer Co., Cincinnati, O.

Name Plates—
August Becker, Boston, Mass.

Nickel Plating Outfits—
Northampton Emery Wheel Co., Chicago, Ill.

Nuts and Bolts
Rockford Bolt Works, Rockford, Ill.
Upson Nut Co., Cleveland, O.

Oilless Bearings—
North American Metaline Co., Long Island City, N. Y.
C. H. Besly & Co., Chicago, Ill.

Oil Burners—
W. S. Rockwell & Co., New York City.
American Gas Furnace Co., New York City.

Oil Cups—
C. H. Besly & Co., Chicago, Ill.

Oil Pumps—
C. H. Besly & Co., Chicago, Ill.

Ore Crushers—
The Edward P. Allis Co., Milwaukee, Wis.
Jeffrey Mfg. Co., Columbus, O.
The Aultman Co., Canton, O.

Ore Screens—
Rob't Aitchison Per. Metal Co., Chicago, Ill.
Harrington & King Per. Co., Chicago, Ill.
The Aultman Co., Canton, O.

Packing—
C. H. Besly & Co., Chicago, Ill
Jenkins Bros., New York City.

Paint—
Iron Clad Paint Co., Cleveland, O.
Jos. Dixon Crucible Co., Jersey City, N. J.
Standard Paint Co., New York, City.

Pattern Letters—
Heber Wells, New York City.

Pattern Makers' Vises—
Massey Vise Co., Chicago, Ill.

Pattern Works—
Gobeille Pattern Co., Cleveland O.

Perforated Sheet Metal—
Harrington & King Perforating Co., Chicago, Ill
Aitchison Perforated Metal Co., Chicago, Ill.

Pig Iron—
Clinton Iron & Steel Co., Pittsburg.
Forster, Waterbury & Co., Chicago, Ill.
Bourne-Fuller Co. Cleveland, O.
M. A. Hanna & Co., Cleveland, O.
E. H. Stroud & Co., Chicago, Ill.
F. B. Stevens, Detroit, Mich.
McKeefrey & Co., Leetonia, O.
Superior Charcoal Iron Co., Grand Rapids, Mich
Hickman & Williams, Chicago, Ill.
Shenango Valley Steel Co., New Castle, Pa.
Spearman Iron Co., Sharpsville, Pa.
Salisbury Carbonate Iron Co., New York City.

Pipe Covering—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.

Pipe Cutting and Threading Machines—
The Armstrong Mfg. Co., Bridgeport, Conn.

Planers—
U. Baird Machinery Co., Pittsburg, Pa.
Bickford Drill & Tool Co., Cincinnati, O.

Planer Chucks—
Massey Vise Co., Chicago, Ill.

Plates—
Enterprise Boiler Co., Youngstown, O.

Plumbago—
The S. Obermayer Co., Cincinnati, O.

Plumbers' and Gas Fitters' Supplies—
C. H. Besly & Co., Chicago, Ill.

Pneumatic Appliances—
Clayton Air Compressor Works, New York.

Pneumatic Tools.—
American Pneumatic Tool Co., New York City

Portable Forge—
C. H. Besly & Co., Chicago, Ill.
B. F. Sturtevant Co., Boston, Mass.
Vulcan Mfg. Co., Pittsburg, Pa.

Power Drop Hammers—
Baush & Harris Machine Tool Co., Springfield Mass.

Power Presses—
Bertsch & Co., Cambridge City, Ind.
Fox Machine Co., Grand Rapids, Mich.
E. Konigslow & Bro. Cleveland, O.

Power Transmission Machinery—
Jeffrey Mfg. Co., Columbus, O.
The Lane & Bodley Co., Cincinnati, O.
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.

Presses—
Bertsch & Co., Cambridge City, Ind.
C. H. Besly & Co., Chicago, Ill.
E. Konigslow & Bro. Cleveland, O.

Pressure Gauges—
The Bristol Co., Waterbury, Conn.

Pulleys—
W. A. Jones Foundry Co., Chicago, Ill.
The Lane & Bodley Co., Cincinnati, O.
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.

Pumps (Steam)—
The Edward P. Allis Co., Milwaukee, Wis.
Stilwell-Bierce & Smith-Vaile Co., Dayton, O.
Blakeslee Mfg. Co., Du Quoin, Ill.
Fred M. Prescott Steam Pump Co., Milwaukee, Wis.
Hall Steam Pump Co., Pittsburg, Pa.

Punches—
Ferracute Machine Co., Bridgeton, N. J.
E. Konigslow & Bro. Cleveland, O.

Pyrometers—
Edward Brown, Philadelphia, Pa.
Uehling, Steinbart & Co., Newark, N. J.
Vulcan Mfg. Co., Pittsburg, Pa.

Railway Supplies—
Cleveland City Forge & Iron Co., Cleveland, O.

Rivets—
Champion Rivet Co., Cleveland, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.

Riveted Steel Pipe—
Wm. B. Pollock & Co. Youngstown, O.

Rock Drills—
Rand Drill Co., Chicago, Ill.
The Ingersoll-Sergeant Drill Co., New York.

Roofs—
Shiffler Bridge Co., Pittsburg.
Berlin Iron Bridge Co., East Berlin, Conn.
Pittsburg Bridge Co., Pittsburg, Pa.
Riter-Conley Mfg. Co., Pittsburg, Pa.

Sand and Chill Rolls—
Seaman, Sleeth Co., Pittsburg, Pa.

Saws—
Peter Gerlach & Co., Cleveland, O.

Screens for Coal Ore, Etc.
Robt. Aitchison Perforated Metal Co., Chicago.
Harrington & King Perforating Co., Chicago.
Jeffrey Mfg. Co., Columbus, O.
The Aultman Co., Canton, O.

Screws—
C. H. Besly & Co., Chicago, Ill.
Upson Nut Co., Cleveland, O.
Chicago Screw Co., Chicago, Ill
Rockford Bolt Works, Rockford, Ill.

Shafting—
The Lane & Bodley Co., Cincinnati, O.
E. A. Delano, Chicago, Ill.
Dodge Mfg. Co., Mishawaka, Ind.
Fitzsimmons & Co., Cleveland, O.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
Jones & Laughlins, Ltd., Pittsburg, Pa

Shapers—
Baush & Harris Machine Tool Co., Springfield, Mass.

Shearing and Punching Machinery—
Bertsch & Co., Cambridge City, Ind.
Fox Machine Co., Grand Rapids, Mich.
The Long & Allstatter Co., Hamilton, O.
Ferracute Machine Co., Bridgeton, N. J.

Sheet Iron—
Cleveland Rolling Mill Co., Cleveland, O.
Ætna-Standard Iron & Steel Co., Bridgeport, O.
E. H. Stroud & Co., Chicago, Ill.

Ship Yards—
Wm. Cramp & Sons, Philadelphia, Pa.

Special Machinery—
Edwin Harrington Son & Co., Philadelphia.
Q & C Co., Chicago, Ill.
A. H. Nilson Machine Co., Bridgeport, Conn.
The Aultman Co., Canton, O.
Jeffrey Mfg. Co., Columbus, O.
E. Konigslow & Bro. Cleveland, O.

Stand Pipes—
Wm. B. Pollock & Co., Youngstown, O.

Steam Boiler Inspectors—
Hartford Steam Boiler Inspection & Insurance Co., Hartford, Conn.

Steam Pipe and Boiler Covering—
C. H. Besly & Co., Chicago Ill.

Steam Packing—
C. H. Besly & Co., Chicago, Ill.

Steam Pumps—
Hall Steam Pump Co., Pittsburg, Pa.
Stilwell-Bierce & Smith-Vail Co., Dayton, O.
Blakeslee Mfg. Co., Du Quoin, Ill.

Steam Shovels and Dredges—
Marion Steam Shovel Co., Marion, O
The Bucyrus Co., South Milwaukee, Wis.

Steam Specialties—
C. H. Besly & Co., Chicago, Ill.

Steel—
Otis Steel Co., Cleveland, O.
Miller, Wagoner, Fieser & Co., Chicago, Ill.
E. H. Stroud & Co., Chicago, Ill.
Bræburn Steel Co., Bræburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa.
The Morris & Bailey Steel Co., Pittsburg, Pa.
Sanderson Bros. Steel Co., Cleveland, O.
Byron H. White, Chicago, Ill.

Steel Castings—
Otis Steel Co., Cleveland, O.
Q & C Co., Chicago, Ill.
Hanson McDowell, Chicago, Ill.

Steel Plants—
Wm. B. Pollock & Co., Youngstown, O.
The Riter-Conley Co., Pittsburg, Pa.

Steel Blooms and Billets—
Cleveland Rolling Mill Co. Cleveland.
Bethlehem Iron Co., South Bethlehem, Pa.
Ohio Steel Co., Youngstown, Ohio.
Shenango Valley Steel Co., New Castle, Pa.
The Lorain Steel Co., Lorain, O.
Jones & Laughlins, Ltd., Pittsburg, Pa.

Steel Stamps and Stencils—
J. H. Fleharty & Co., Cleveland, O.

Semi-Steel—
Hanson McDowell, Chicago, Ill.

Stokers—
Playford Stoker Co., Cleveland, O.

Tanks—
Enterprise Boiler Co., Youngstown, O
Meehan Boiler & Construction Co., Lowellville Ohio.
Wm. B. Pollock & Co., Youngstown, O.
Riter-Conley Mfg. Co., Pittsburg, Pa.
The Aultman Co., Canton, O.

Tank Cars—
Wm. B. Pollock & Co., Youngstown, O

Tin and Terne Plates—
B. P. Crane & Co., Chicago, Ill.
E. H. Stroud & Co., Chicago, Ill.
American Tin Plate Company, Chicago, Ill.

Tool Steel—
C. H. Besly & Co., Chicago, Ill.
Bræburn Steel Co., Bræburn, Pa.
Crescent Steel Co., Pittsburg, Pa.
La Belle Steel Co., Pittsburg, Pa.
Sanderson Bros. Steel Co., Cleveland, O.

Transmission Machinery—
Heyl & Patterson, Pittsburg, Pa.
Link-Belt Machinery Co., Chicago, Ill.
The Lane & Bodley Co., Cincinnati, O.
W. A. Jones Foundry & Machine Co., Chicago, Ill
Jeffrey Mfg. Co., Columbus, O.
Dodge Mfg. Co., Mishawaka, Ind.
The Aultman Co., Canton, O.
Brown Hoisting and Conveying Machine Co., Cleveland, Ohio.

Tubes—
National Tube Works, McKeesport, Pa.

Tube Welding—
S. Fix Sons, Cleveland, O.

Tumbling Mills—
The S. Obermayer Co., Cincinnati, O.

Turnbuckles—
Cleveland City Forge & Iron Co., Cleveland, O.

Twist Drills—
C. H. Besly & Co., Chicago, Ill.

Twist Drill Cases—
Vulcan Mfg. Co., Pittsburg, Pa.

Valves—
C. H. Besly & Co., Chicago, Ill.
Jenkins Bros., New York City.

Ventilating Fans—
B. F. Sturtevant Co., Boston Mass.

Vises—
Massey Vise Co., Chicago, Ill.

Wire Machinery—
The F. B. Shuster Co., New Haven, Conn.
S. W. Goodyear, Waterbury, Conn.
A. H. Nilson Machine Co., Bridgeport, Conn.

Wire Nails—
Cleveland Rolling Mill Co., Cleveland, O.
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Wood Pulleys—
Dodge Mfg. Co., Mishawaka, Ind.

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Illinois Central R. R	43
Ingersoll-Sargent Drill Co	2
Iron Clad Paint Co	40
Jeffrey Mfg. Co	31
Jenkins Bros	40
Jones & Co., John T	2
Jones Foundry & Machine Co., W. A	1
Jones & Laughlins, Ltd	41
Kentucky Fire Brick Works	24
Konigslow & Bro., E	27
La Belle Steel Co	37
Lake Superior Consolidated Iron Mines	28
Lane & Bodley	39
Lidgerwood Mfg Co	30
Link-Belt Machinery Co	30
Lorain Steel Co	41
Lusch, H. B	2
Main Belting Co	27
Marion Steam Shovel Co	44
Massey Vise Co	1
McDowell, Hanson	24
McKeefrey & Co	28
Meehan Boiler & Construction Co	44
Millers Falls Co	44
Millett Core Oven Co	32
†Modern Machinery	—
Morris & Bailey Steel Co	37
*National Engraving Co	—
National Tube Works Co	43
†Newport Sand Bank Co	—
Nilson, A. H., Machine Co	37
North American Metaline Co	44
Northampton Emery Wheel Co	38
Norwalk Foundry & Machine Co	33
Nuttall Co. The R. D	26
Oak Hill Fire Brick & Coal Co	23
Obermayer, S. & Co	29
Oglebay, Norton & Co	28
†Ohio Sand Co	—
Ohio Steel Co	28
Otis Steel Co	23
†Parkhurst & Wilkinson Co	37
Phœnix Horse Shoe Co	43
Playford Stoker Co	40
Pollock, Wm. B. & Co	2
Prescott Steam Pump Co	39
Q & C Co	22
Rand Drill Co	2
Reading Crane & Hoist Works	30
Riter-Conley Mfg. Co	31
Riverside Foundry Co	23
Rockford Bolt Works	2
Rockwell & Co., W. S	1-24
Ryan, J. J. & Co	26
Salisbury Carbonate Iron Co	26
Sanderson Bros. Steel Co	37
Seaman, Sleeth Co	42
Sennett Co., Geo. B	39
Scioto Star Fire Brick Works	29
‖Sharon Fire Brick Works	1
Shenango Valley Steel Co	34
Shiffler Bridge Co	31
Shuster, The F. B., Co	27
Skinner Chuck Co	27
Spearman Iron Co	44
Standard Paint Co	24
Stevens, F. B	44—
Stilwell-Bierce & Smith-Vaile Co	2
Stroud & Co., E. H	2
Sturtevant Co., B. F	1-32
*Superior Charcoal Iron Co	—
Swarts Metal Refining Co	1
Tabor Mfg Co	29
Textor, O	2
Tod, Wm. & Co	39
*Uehling, Steinbart & Co	—
Union Mining Co	23
Union Boiler Tube Cleaner Co	1
United States Hotel Co	38
Upson Nut Co	1
Van Dorn & Dutton Co	26
Vitrified Wheel Co	38
Vulcan Mfg. Co	30
Washington Coal and Coke Co	33
Webster Fire Brick Co	1
Wells, Heber	42
White, Byron H	37
Wyman & Gordon	43

BRÆBURN STEEL COMPANY, Bræburn, Pa.
MANUFACTURERS OF
FINE TOOL STEEL AND FORGINGS. ALSO SPRING HAMMER, AND MACHINERY STEEL OF HIGH QUALITY. FINE OPEN-HEARTH STEEL.

DIRECTORS:
Wm. Metcalf,
Chas. Metcalf,
P. B. Hasbrouck.
R. P. Kelly,
Sec'y. and Treas.

MORE WEAR from your tools
.....Almost no **STEEL EXPENSE**
NO TROUBLE

"It pays to use the most reliable tool steel in the market."

SANDERSON BROS. STEEL CO.
Cleveland Warehouse, 97 Water St.

CRESCENT STEEL
ESTABLISHED 1865 ✱ INCORPORATED 1889.
CRESCENT STEEL CO.
480 PEARL ST. NEW YORK — PITTSBURGH, PA. — 64 & 66 S. CLINTON ST. CHICAGO.

La BELLE STEEL CO., Pittsburgh, Pa.
MANUFACTURERS OF FINE
CRUCIBLE CAST TOOL STEEL.
SPECIAL GRADES FOR ALL PURPOSES.
BYRON H. WHITE,
Western Selling Agent.
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FITZSIMONS & CO., CLEVELAND, OHIO
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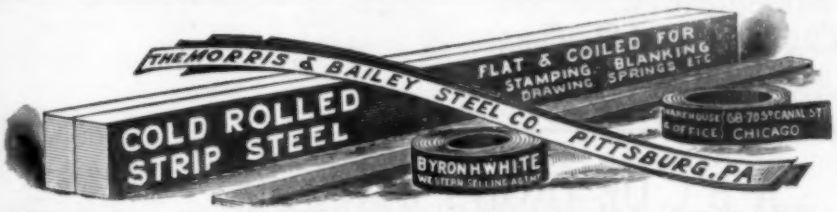
THE MORRIS & BAILEY STEEL CO. PITTSBURG, PA
COLD ROLLED STRIP STEEL
FLAT & COILED FOR STAMPING BLANKING DRAWING SPRINGS ETC
WAREHOUSE & OFFICE 68 70 S. CANAL ST CHICAGO
BYRON H. WHITE WESTERN SELLING AGENT

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OUR NEW
University Bicycle Saddle
WILL SOON BE READY.
LOOK FOR IT.
Parkhurst & Wilkinson Co.,
146-164 Kinzie Street, CHICAGO.

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THE GOBEILLE PATTERN CO., Cleveland.

Between the Lakes and the Gulf, the Mississippi and the Allegheny Mountains—the best buying section of the United States—is the BULK of THE IRON TRADE REVIEW'S circulation. In this section advertisers in all trade papers get best returns.

IRON AND STEEL MARKETS.

IRON ORE.
[On Lake Erie docks.]

Special low-phosphorus hard Ore, Bessemer	3.65
No. 1 Specular, Bessemer	3.01@3.35
No. 1 Bessemer hematite	2.75@3.25
Hematites No. 1 non-Bessemer	1.90@2.10
No 1. Specular, non-Bessemer	2.00@2.40
Mesabi Bessemer	1.80@2.00

PIG IRON.

CLEVELAND (f. o. b. cars):	
Bessemer	13 65
No. 1 Strong Foundry	13 75@14 25
No. 2 Strong Foundry	13 25@13 75
Gray Forge, red short	12 65
Gray Forge, neutral	13 50
No. 1 American Scotch	14 15
No. 2 American Scotch	13 65
Lake Superior Charcoal	14 50@15 00
PITTSBURG:	
No. 1 Foundry	$13 50@14 00
No. 2 Foundry	13 00@14 00
Gray Forge	12 50@12 65
White and Mottled	9 50
Warm Blast Charcoal	13 00@13 50
Cold Blast Charcoal	22 00@26 00
Bessemer	12 75
CHICAGO:	
Lake Superior Charcoal	$14 50@$16 00
Local Coke Foundry No. 1	14 50@15 00
Local Coke Foundry No. 2	14 00@14 50
Local Coke Foundry No. 3	13 50@14 00
Local Scotch Foundry No. 1	14 50@15 00
Local Scotch Foundry No. 2	14 00@14 50
Local Scotch Foundry No. 3	13 50@14 00
Southern Coke No. 1	14 50@15 00
Southern Coke No. 2	14 25@14 50
Southern Coke No. 3	13 75@14 25
Southern No. 1 Soft	14 50@15 00
Southern No. 2 Soft	14 25@14 50
Southern Silveries	14 50@15 00
Jackson Co. Silveries	14 50@15 00
Ohio Silveries No. 1	[illegible]
Ohio Strong Softeners	14 00@14 50
Alabama Car Wheel	17 50@18 00
Malleable Bessemer	14 50@15 00
Coke Bessemer	14 50@15 00
CINCINNATI (reported by Rogers, Brown & Co.	
Southern Coke No. 1, Foundry	$13 00@13 25
Southern Coke No. 2 and No. 1 Soft	12 50@12 75
Hanging Rock Coke, No 1	11 00
Hanging Rock Charcoal No. 1, Fdy	16 00@17 00
Tennessee Charcoal No 1	14 00@14 25
Jackson County Silvery No 1	13 25@13 50
Southern Coke, Gray Forge	11 50@11 75
" " Mottled	11 50@11 75
Standard Georgia Car Wheel	14 75@15 75
Tennessee " "	13 00@14 00
Lake Superior " "	14 25@14 50
BUFFALO:	
No. 1 Foundry Strong Coke Iron Lake Superior Ore	
No. 2 Foundry Strong Coke Iron Lake Superior Ore	
Ohio Strong Softener No. 1	
Jackson Co. Silvery No. 1	
Lake Superior Charcoal	
Southern Soft No. 1	
" " No. 2	
ST. LOUIS:	
Southern Coke No 1	
Southern Coke No. 2	
Southern Coke No. 3	
Southern Gray Forge	
Southern Charcoal No. 1	
Missouri Bessemer	
Lake Superior Car Wheel	
Ohio Softeners	
Southern Car Wheel	

OLD RAILS AND SCRAP METAL.

[Delivered Cleveland.]	Gross Tons
Old iron rails	$16 00
Old steel rails (6 ft. and over)	11 00
Old steel rails (6 ft. and under)	11 00
Old car wheels	13 00
	Net Tons
No. 1 R. R. wrought scrap	$14 00
Mill scrap	9 75
No. 1 Machine cast scrap	9 50
Iron axles	16 50
Axle turnings	9 00
Wrought turnings (free from cast)	8 00
Cast borings	6 75
Uncut wrought iron boilers	5 00
Steel boiler plates	9 50
Grate bars	7 00
Pipes and flues (clean)	9 00
Tank iron	10 00
Hoop and band iron	7 50
Sheet iron	6 00
Wrought drillings	8 00
Malleable Iron	8 50

STRUCTURAL MATERIAL.

Beams and Channels (f. o. b. Cleveland)	1.50c
Angles	1.40c
Tees	1.50c
Universal Plates	1.80@1.90c
Sheared Plates	1.90c

MERCHANT IRON AND STEEL.
[Less than car-lots, Cleveland.]
Rounds and Squares.—Bar Iron.

1 to 1⅞	1.05 Base.
2 to 2⅞	.20 extra.
3 to 3⅝	.50 "
3⅝ to 4	.80 "
4⅛ to 4¾	1.00 "
4⅞ to 5	1.30 "
5⅛ to 6	1.50 "
5¼ to 6¾	[illegible] "

VITRIFIED EMERY AND CORUNDUM WHEELS. . .

—FOR—

Foundry and Machine Shop Work.

CAN BE RUN WET OR DRY.

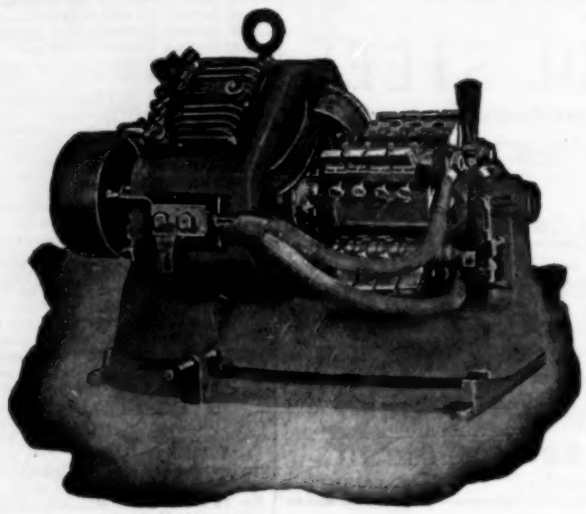
SOLD BY
Weed & Co., Buffalo, N. Y.
Strong, Carlisle & Hammond Co , Cleveland, O.
Machinist Supply Co., Chicago, Ill.
Sligo Iron Store Co., St. Louis, Mo.

VITRIFIED EMERY WHEEL CO.,
Westfield, Mass.

Eddy Dynamo Electro-Plating Machines

—— FOR ——

BICYCLE PLATING PLANTS.



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EXCLUSIVE WESTERN SELLING AGENTS.

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THE U.S. HOTEL CO.
C.A. SWAN & W.L. BATES
MANAGERS

50 ROOMS AT $2.00
50 ROOMS AT 2.50
75 ROOMS AT 3 TO 4.00
All Meals
50¢ Each

...A B C OF IRON...

A book for foundrymen. It is issued in cloth binding, and gives much valuable matter on how to reduce cost of mixtures, and on grading and numbering of pig iron.

CHAPTER HEADINGS:—Iron—What is it? Pig Iron. Constituents of Iron. Numbering of Pig Iron. Grading of Iron. How to reduce cost of mixture. Steel Physical Properties of Metals Defined. Statistics. Early History and Manufacture of Iron.

Former Price, $2.00. NOW $1.00.

Sent, postpaid, on receipt of price, by

THE IRON TRADE REVIEW CO.,
CHICAGO. CLEVELAND. PITTSBURG

Metallurgy of Cast Iron, Price $3.00.

6⅝ to 7¼	2.50 extra
¼ to ⅜	.10 "
⅜ to 11-16	.20 "
½ to 9-16	.30 "
7-16 to 15-32	.40 "
⅜ to 13 2	.50 "
5-16 to 32	.70 "
¼ to 9-32	.90 "
7-32	1.40 "
3-16	2.50 "

Flats.—Bar Iron.

1⅛ to 4 x ⅛ to 1	1.05 Base
4¼ o 6 x ⅛ to 1	.10 extra
6¼ o 8 x ⅛ to 1	.60 "
8¼ o 10 x ⅛ to 1	.80 "
1⅛ o 4 x 1 1-16 to 1¼	.30 "
4¼ to 6 x 1 1-16 to 1¼	.40 "
6¼ to 8 x 1 1-16 to 1¼	.60 "
8¼ to 10 x 1 1-16 to 1¼	.90 "
2 to 4 x 1⅜ to 2	.50 "
4¼ to 6 x 1⅜ to 2	.60 "
6¼ to 8 x 1⅜ to 2	.80 "
8¼ to 10 x 1⅜ to 2	1.00 "
2 to 4 x 2⅜ to 3	.60 "
4¼ to 6 x 2⅜ to 3	.80 "
6¼ to 8 x 2⅜ to 3	1.00 "
1⅛ to 1⅜ x ⅛ to 1	.10 "
1 to 1 1-16 x ⅛ to ⅞	.20 "
¼ to 15-16 x ⅛ to ¼	.40 "
⅜ to 11-16 x ⅛ to ⅜	.50 "
¼ to 9-16 x ⅛ to ½	.90 "

Heavy Band Iron.

7 to 10 x ¼ to 5-16	.70 extra.
6¼ to 6¾ x ¼ to 5-16	.50 "
4¼ to 6 x ¼ to 5-16	.30 "
1⅛ to 4 x ¼ to 5-16	.20 "
1 to 1⅜ x ¼ to 5-16	.30 "
¼ to 15-16 x ¼ to 5-16	.50 "
⅜ to 11-16 x ¼ to 5-16	.80 "
½ to 9-16 x ¼ to 5-16	1.00 "
⅝ to 7-16 x ¼ to 5-16	1.50 "

Heavy bands, 7-32 in. thick 1-10 c. per lb. higher than ¼ to 5-16 thick. **Bevel Edge Shaft Iron** 1-10 higher than same size of Heavy Bands.

Light Band Iron.

7 to 8 x No. 9 to 3-16	.90 extra
7 to 8 x Nos. 10, 11 and 12	1.00 "
6¼ to 6¾ x No. 9 to 3-16	.70 "
6¼ to 6¾ x Nos. 10, 11 and 12	.80 "
4¼ to 6 x No. 9 to 3-16	.50 "
4¼ to 6 x Nos. 10, 11 and 12	.60 "
1⅛ to 4 x No. 9 to 3-16	.40 "
1⅛ to 4 x Nos. 10, 11 and 12	.50 "
1 to 1 3-16 x No. 9 to 3-16	.50 "
1 to 1 3-16 x Nos. 10, 11 and 12	.60 "
13-16 to ⅞ x No. 9 to 3-16	.60 "
13-16 to ⅞ x Nos. 10, 11 and 12	.70 "
11-16 to ¾ x No. 9 to 3-16	.80 "
11-16 to ¾ x Nos. 10, 11 and 12	.90 "
9-16 to ⅝ x No. 9 to 3-16	1.00 "
9-16 to ⅝ x Nos. 10, 11 and 12	1.10 "
7-16 to ½ x No. 9 to 3-16	1.30 "
7-16 to ½ x Nos. 10, 11 and 12	1.40 "
⅜ x No. 9 to 3-16	1.50 "
⅜ x Nos. 10, 11 and 12	1.60 "

Bevel Edge Box Iron.

Same as Light Bands, of same sizes.

Beaded Band Iron, 1¼ in. to 2 in.

Sand Band Iron, 1-10 c. above same sizes o Light Bands.

Oval Iron.

⅜ to 1½	.40 extra.
¾ to 13-16	.50 "
⅝ to 11-16	.60 "
½ to 9-16	.80 "
⅜ to 7-16	1.10 "
½ to 9-16 x 3-16	1.00 "
⅝ to 11-16 x ⅛	1.20 "

Half Oval and Half Round.

2¼ to 3	.60 extra
⅝ to 2	.50 "
¼ to 13-16	.70 "
⅝ to 11-16	.90 "
½ to 9-16	1.20 "
⅜ to 7-16	2.50 "
5-16	3.50 "
¼	4.50 "

Half Ovals less than ¼ their width in thickness, extra price.

Horse Shoe Iron.

All sizes 1 c. extra.

Cutting ordinary bars to specified length, .20 to .30 extra, according to length and size.

Steel Bands.

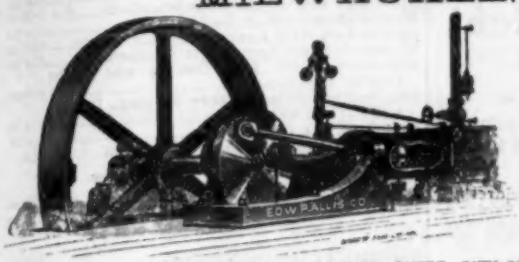
Width In Inches.	English Standard Gauge.		
1 1-2 to 6,	Nos. 7, 8, 9 or 3-16 "	1.50	Base.
			Extras.
1¼ to 6,	" 10, 11, 12 or ⅛"	.05	per 100 lbs.
1 to 1¾,	" 7, 8, 9 or 3-16"	.10	"
1 to 1¾,	" 10, 11, 12 or ⅛"	.15	"
13-16 and ⅞,	" 7, 8, 9 or 3-16"	.20	"
13-16 and ⅞,	" 10, 11, 12 or ⅛"	.25	"
11-16 and ¾,	" 7, 8, 9 or 3-16"	.30	"
11-16 and ¾,	" 10, 11, 12 or ⅛"	.35	"
9-16 and ⅝,	" 7, 8, 9 or 3-16"	.40	"
9-16 and ⅝,	" 10, 11, 12 or ⅛"	.45	"
½,	Nos. 7, 8, 9 or 3-16"	.55	"
½,	" 10, 11, 12 or ⅛"	.60	"
⅜,	" 7, 8, 9 or 3-16"	.75	"
7-16	" 10, 11, 12 or ⅛"	.85	"
7-19	" 7, 8, 9 or 3-16"	.95	"
¼,	" 10, 11, 12 or ⅛"	1.05	"

Iron and Steel Hoops.

Width Inches.	English Standard Gauge.		
7-16 to 3	Nos. 13, 14, 15 and 16	1.60	Base
			Extras.
7-16 to 2,	" 17, 18, and 19	.05	per 100 lb
7-16 to 2,	" 20	.10	"
7-16 to 2,	" 21	.15	"
7-16 to 1¾,	" 22	.25	"
¼ to 1¾,	" 13, 14 and 15	.05	"
¼ to 1¾,	" 16, 17 and 18	.10	"

THE EDWARD P. ALLIS COMPANY

MILWAUKEE, WIS.



MANUFACTURERS OF

Blowing Engines, Hoisting Engines, Pumping Engines Air Compressors. Special Engines for Electric Lighting Street Railways and Rolling Mills. Ore Crushers, Crushing Rolls, Stamp Mills Concentrators, General Mining Milling and Smelting Machinery.

Reynolds Corliss Engines.

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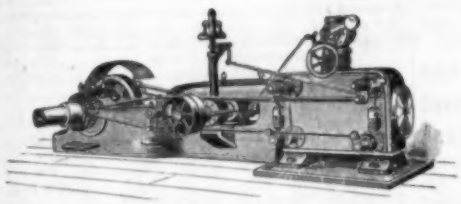
THE LANE & BODLEY CO.,

CINCINNATI, OHIO.



Engines,

ALL SIZES.

Simple and Compound.

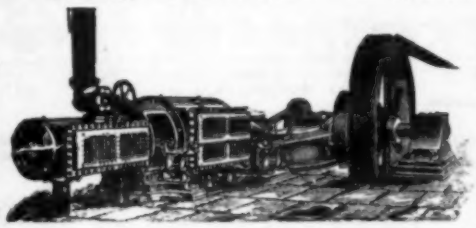
Shafting, Hangers, Pullevs.

Belt Elevators, Saw Mills.

WILLIAM TOD & CO.

YOUNGSTOWN, OHIO.

The Porter-Hamilton Engine



Reversing Engines, Blowing Engines, Converters, Hydraulic and special heavy machinery for the iron and steel trades.

Park Building, Pittsburg.

SEWARD S. BABBITT.

Who builds the best Mine Pump?

PRESCOTT.

Fred. M. Prescott Steam Pump Co.,

MILWAUKEE, WIS.

The Geo. B. Sennett Co., Youngstown, Ohio,

MANUFACTURERS OF

Sennett Compression Coupling

And Other Specialties.

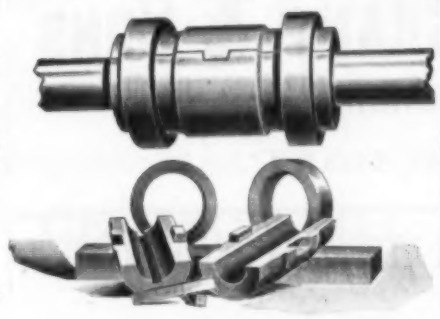
We do not claim novelty in these Couplings so much as good material, good workmanship and extreme simplicity. We make them of a very strong cast iron, with wrought iron bands.

We make also the

SENNETT ENGINE

20 to 40 H. P.

Foundry contracts solicited for duplicate castings, from 10 lbs. to 5 tons each.



1⅛ to 1⅜,	"	19 and 20	per 100 lbs.
1⅛ to 1⅜,	"	21	.30 "
1⅛ to 1⅜,	"	22	.30 "
15-16 and 1,	"	13, 14 and 15	.15 "
15-16 and 1,	"	16, 17 and 18	.15 "
15-16 and 1,	"	19 and 20	.20 "
15-16 and 1,	"	21	.25 "
15-16 and 1,	"	22	.35 "
⅞,	Nos.	13, 14 and 15	.20 "
⅞,	"	16, 17 and 18	.25 "
⅞,	"	19 and 20	.30 "
⅞,	"	21	.35 "
⅞,	"	22	.45 "
¾ and 13-16	Nos.	13, 14 and 15	.30 "
¾ and 13-16	"	16, 17 and 18	.35 "
¾ and 13-16	"	19 and 20	.40 "
¾ and 13-16	"	21	.45 "
¾ and 13-16	"	22	.50 "
¾ and 13-16	"	23	.60 "
11-16,	Nos.	13, 14 and 15	.35 "
11-16,	"	16, 17 and 18	.40 "
11-16,	"	19 and 20	.50 "
11-16,	"	21	.60 "
11-16,	"	22	.70 "
11-16,	"	23	.80 "
⅝,	Nos.	13, 14 and 15	.40 "
⅝,	"	16, 17 and 18	.45 "
⅝,	"	19 and 20	.55 "
⅝,	"	21	.65 "
⅝,	"	22	.75 "
⅝,	"	23	.85 "
9-16,	"	13, 14 and 15	.45 "
9-16,	"	16, 17 and 18	.50 "
9-16,	"	19 and 20	.60 "
9-16,	"	21	.70 "
9-16,	"	22	.80 "
9-16,	"	23	.90 "
½,	"	13, 14 and 15	.55 "
½,	"	16, 17 and 18	.60 "
½,	"	19 and 20	.70 "
½,	"	21	.80 "
½,	"	22	.90 "
½,	"	23	1.00 "
7-16,	"	13, 14 and 15	.80 "
7-16,	"	16, 17 and 18	.90 "
7-16,	"	19 and 20	1.00 "
7-16,	"	13, 14 and 15	1.00 "
7-16,	"	16, 17 and 18	1.10 "
7-16,	"	19 and 20	1.20 "

Sheet Iron.

No. 10	1 50
No. 12	1 70
No. 14	1 60
No. 15-17	1 75
No. 18	1 85
No. 20	2 00
No. 22-24	2
No. 25-26	2 20
No. 27	2 30

English Tool Steel.

Jessop's	15½c
Hobson's "Best"	15½c
" "Choice"	35c

Steel Boiler Plates—1-4 in. and Heavier.

Tank	1 35
Shell	1 45
Flange	1 55
Marine Flange	1 60
Fire Box	2 05

Above includes plates 90 inches wide.

90 to 96 in. wide	½c. lb. extra
96 to 100 in. wide	1c. "
100 to 104 in. wide	1½c. "
104 to 106 in. wide	special.

Flats. cts. lbs.

2 to 9-16 in. wide by 2 to ⅝ thick .08

Bessemer and O. H. Steel.

Bessemer Machinery	base price,	1 40
Open-hearth Tire	"	1 45
Open-hearth Spring	"	1 80
Sleigh Shoe	"	1 45
Toe Calk	"	1 90
Cutter Shoes, tapered and bent	"	1 60

American Cast Tool Steel.

ROUND, SQUARE, AND OCTAGON.	cts lbs.
1 to 2 in. inclusive	.08
9-16 to ⅝ in. "	.08
7-16 to ⅜ and 2⅜ to 3 in.	.09
3⅛ to 4 in	09½
⅜ to 11-16 and 4⅛	10
⅛ to 6 in	10½
¼ to 9-32 and 6⅛ to 7 in	11
7 in	13

Burden Boiler Rivets.

½, ⅝, 11-16 and ¾ inches diameter	3 00
Bridge ½, ⅝, 11-16 and ¾ inch diam	2 55

Wrought Pipe and Boiler Tubes.

Lap weld black, base, and 10 per cent	.78
Butt " " " "	.72
Lap " galv. " "	.70
Butt " " " "	.67
Boiler tubes 2¼" and smaller	72½
Boiler tubes 2½" and larger	75
Casting screw and socket joint	dis. 50
Casing inserted joint	dis. 45

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Magnolia Anti-Friction Metal, 25 cts. per lb., f. o. b New York or Chicago.

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American	₩ lb 09@11
Wright's	₩ lb 12

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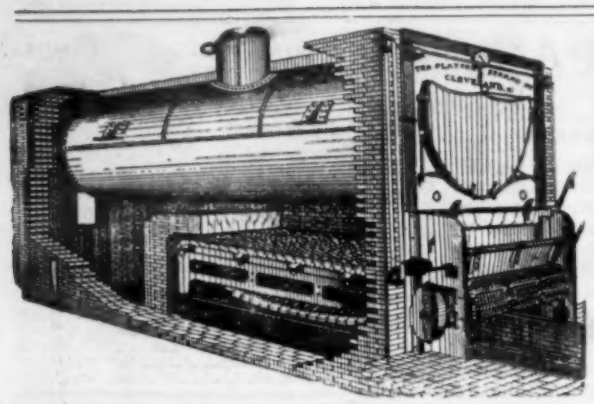
Blacksmiths'	Hill's dis
	Bullock's dis 50 & 1
Moulders'	dis 40@50&10
Hand	dis 40&10@50



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" " " best	dis 35
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Shults Raw Hide Leather Belting, single	dis 40
Munson's Short Lap Single Leather	dis 50
Munson's Short Lap Double and Light Double Leather	dis 50&10
Shults Raw Hide Leather Belting, Double and Light Double	dis 40
Standard, oak tanned	dis 50&10
Alexander Brothers' pure oak tanned	dis

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Boston Blower Co.	dis 35

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Cushman's 4 Jaw Independent	dis 45
" Combination	dis 40
" Geared Scroll	dis 60
" 2 Jaw Brass Workers	dis 30
" Drill	dis 35
Wescott's Scroll Combination	dis 33⅓
" Independent	dis 40
" Little Giant Drill	dis 33⅓
Horton's Independent	dis 45
Whiton's Independent	dis 45
National Combination	dis 45
Sweetland "	dis 40
Almond Drill	dis 40
Morse "	dis 20
Skinner's Combination Lathe	dis 40&15
" Independent Lathe	dis 40&10
" Universal Lathe	dis 40&10
" Drill	dis 30

Cutters and Reamers.

Cleveland	dis 10@15
Pratt & Whitney	dis 10@15
Standard	dis 10@15
Morse	dis 10 to 15
Brown & Sharpe, Milling Cutters	dis 15
" " Gear Cutters	dis 15

Crowbars.

Cast Steel	₩ 3½
Iron, steel points	₩ lb 1

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Twist Drills	
Morse Taper & Straight Shank to 1½"	dis 50 & 10 to 10
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Drill Sockets	dis 25
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Cleveland " "	dis 60@60&5

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	No. 4 to No. 54	150 gr.	F. F
Kegs, ₩ lb	4¾c	5 c	2¾c
½ kegs ₩ lb	4¾c	5¼c	2¾c
¼ kegs ₩ lb	5 c	5½c	3 c
10 lb cans, 10 in case	6 c	6¾c	c
10 lb cans less than 10	10 c	10 c	¼c

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Barder, Adamson & Co.	dis 50@50&5
H. H. Barton	dis 50@50&5

Emery Wheels.

Detroit	dis 60@70
Norton's	dis 60@70
Crant	dis 60@70
Sterling	dis 60@70
Celluloid	dis 10&33⅓
Northampton	dis 50
Crystal	dis 65@70
Vitrified	dis 60@70
Vulcanite	dis 60&10
Hamden	dis 60&10@70
Cyclone	dis 60@60&10

Files.

Arcade	dis 60&10@60&10&10
Nicholson	dis 60&10@60&10&10
" X. F	dis 25
Kearney & Foot	dis 60&10@60&10&10
Black Diamond	dis 60&10@60&10&10
McClellan	dis 60&10@60&10&10
Disston's	dis 65@70
Western	dis 70
Stub's	dis 2
Grobet's	dis 30
Reynolds Bros.' Hand Cut	dis 55
Industry File Works Hand Cut	dis 50

Hammers.

P. S. W	dis 40
Atha new list, Jan. 15, 1887	dis 50
Heavy hammers and sledges under 5 lbs	10c
" " " " over 5 lbs	8c

Jack Screws.

Illinois Bolt Co. list	dis 75

Nuts and Washers.

Size of bolt inches	¼	5-16	⅜	½	⅝	¾	1
Square	8	7	5½	4½	4	3½	3¼
Hexagon	15½	11½	8½	6	5½	5½	
Washers	9	8	7	5	4½	4½	4¼

In lots less than 100 lbs, ₩ lb add ¼c., 1 lb boxes add 1c to list.

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Standard Penny Nails, ₩ keg, base.
{ Car lots $1.30
{ Less than car lots $1.4

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Malleable (Hammer's), No. 1, $3.60; No. 2, $4.00; No. 3, $4.40 ₩ doz	dis 10@10&15

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" 6 to 7 lbs	dis $13 60

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Rivets.

Iron, Thousand, list November 1, 1894	dis 60@10
Iron, Ordinary, Cooper's Block and Carriage list November 1, 1894	dis 60@6
Copper	dis 50@50&15

Taps.

Cards, Hand and Nut to 2 in.	dis 5
Carpenters' " " "	dis 5
Morse " " "	dis 5
Pratt & Whitney " " new list	dis 10
Machine Screw Taps	dis 55
Pipe Taps to 2¾ in.	dis 70
Stay Bolt Taps	dis 25
Stove Bolt Taps	dis 55
Pulley Taps	dis 40

Vises.

Solid Box	dis 60
Parker's	dis 20@25
Prentiss	dis 20
Stephen's	dis 25@30
Barrett's	dis 30
Miller's Falls	dis 40
Merrill's	dis 15@20
Howard	dis 35

Wire.

List, Apr. 9, 1894

Brass	dis 35
Copper	dis 35
Bright and annealed, Nos. 0@18	dis 70&10@75
" " Nos. 19@26	dis 75@75& 5
" " Nos. 27@36	dis 75&10& 5
Coppered Nos. 0 to 18, market list	dis 70@70& 5
Galvanized Nos. 0 to 18 " "	dis65& 5
Tinned market Nos. 0 to 18	dis 67½
Cast steel	dis 50
Tinned Broom Wire	dis 70&5@70&10
Annealed Fence, Nos. 8 and 9	dis 75
Annealed Grape, Nos. 10 to 14	dis 75
Stub's Steel Wire regular	95c ₱ lb dis 30

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Cleveland Press Special	†9:25 P M	†2:00 P M
Akron, Canton & Wheeling	*10:20 A M	*3:30 P M
Akron, Canton & Chicago	*8:05 A M	*6:35 P M
Akron, Canton & Marietta	†2:10 P M	†11:00 A M
Pittsburg, Washington, D. C., & Baltimore	*11:30 A M	†2:00 P M
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Cleveland Depot: Foot of South Water Street.
Elyria Depot: Huron St., West Side.

South Bound.			Central Standard. Lorain Branch	North Bound.		
18	13	11		12	14	16
P.M.	P.M.	A.M.	LV. AR.	A.M.	A M	P.M.
4:25	2:25	6:27	Lorain	9:15	11:35	7:30
4:40	2:30	6:44	Elyria	9:00	11:21	7:16
4:56	2:55	7:04	Grafton	8:43	11:07	6 58
5:15	3:12	7:23	Lester	8:25	10:50	6:40
5	3	1	Main Line	2	4	6
5:30	2:25	7:20	Cleveland	8:30	11:50	7:15
5:47	2:41	7:36	Brooklyn	8:14	11:34	7:01
6:42	3:26	8:22	Lester	7:29	10:49	6:19
6:52	3:35	8:30	Medina	7:16	10:37	6:07
7:05	3:46	8:41	Chippewa La	7:04	10:26	5:55
7:20	4:01	8:56	Sterling	6:48	10:12	5:40
8:09	4:46	9:45	Massillon	6:00	9:23	4:54
8:55	5:31	10:34	Canal Dover	5:11	8:36	4:10
9:02	5:38	10:41	New Philade	5:04	8:28	4:03
9:20	6:05	11:25	Uhrichsville	4:45	8:10	3:45
	8:10	1:30	Bridgeport		6:05	1:40
	8:25		Bellaire		5:50	
P.M.	P.M.	P.M.	AR. LV.	A.M.	A.M	P M.

No. 9 leaves Lorain 9:50 a.m., Elyria 10:05, Grafton 10:21; arrives Lester Junction 10:40. No. 10 leaves Lester Junction 3:25 p.m., Grafton 3:42, Elyria 3:57; arrive Lorain at 4:10 p.m.

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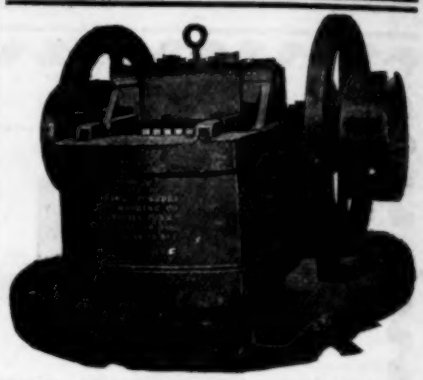

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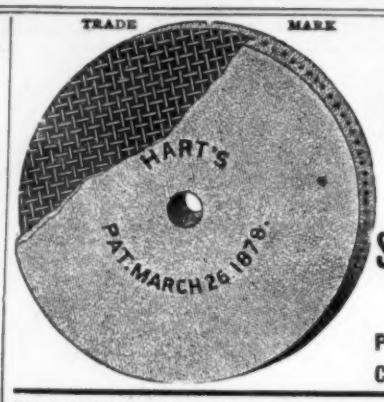

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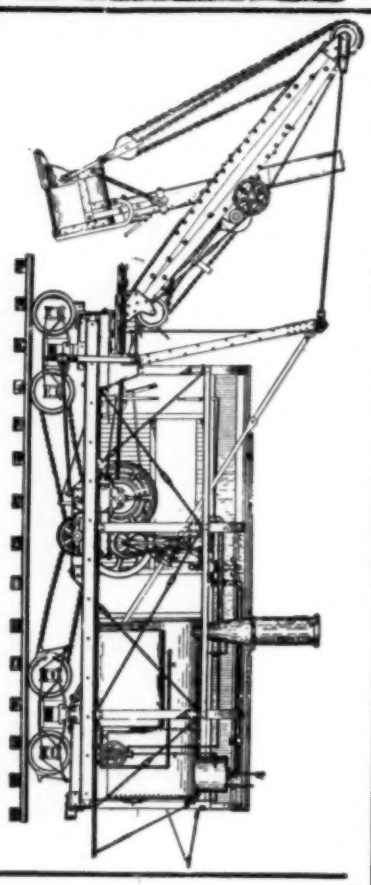

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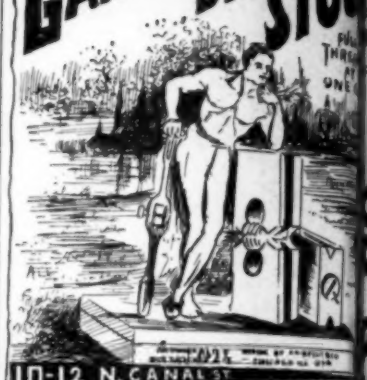

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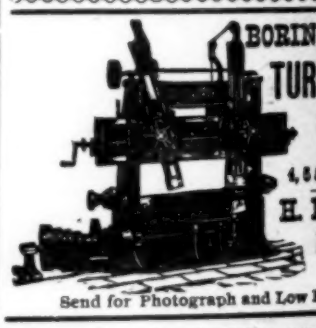

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